PROCEEDINGS

OF THE

THIRTY-EIGHTH ANNUAL MEETING

OF THE

FLORIDA STATE HORTICULTURAL SOCIETY

HELD AT

EUSTIS, FLA., APRIL 7, 8 AND 9,

1925

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Florida State Horticultural Society

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EXECUTIVE COMMITTEE:

FRANK STIRLING, Gainesville; B. L. HAMNER, Tampa

H. HAROLD HUME, Glen St. Mary; President, Secretary and Treasurer, ex-officio

Constitution

Article 1. This organization shall be known as The Florida State Horticultural Society, and its object shall be the advancement of Horticulture.

Article 2. Any person or firm may become an annual member of the Society by subscribing to the Constitution and paying two dollars. Any person or firm may become a perennial member of the Society by subscribing to the Constitution and paying the annual dues for five or more years in advance. Any person may become a life member of the Society by subscribing to the Constitution and paying twenty-five dollars. Any person or firm may become a patron of the Society by subscribing to the Constitution and paying one hundred dollars.

Article 3. Its officers shall consist of a President, three Vice-Presidents, Secretary, Treasurer, and Executive Committee of three, who shall be elected by ballot at each annual meeting. After the first election their term of office shall begin on the first day of January following their election.

Article 4. The regular annual meeting of this Society shall be held on the second Tuesday in April, except when otherwise ordered by the Executive Committee.

Article 5. The duties of the President, Vice-Presidents, Secretary and Treasurer shall be such as usually devolve on those officers. The President, Secretary and Treasurer shall be ex-officio members of the Executive Committee.

Article 6. The Executive Committee shall have authority to act for the Society between annual meetings.

Article 7. The Constitution may be amended by a vote of two-thirds of the members present.

By-Laws

1. The Society year shall be co-extensive with the calendar year, and the annual dues of members shall be two dollars.

2. All bills authorized by the Society or its Executive Committee, for its legitimate expenses, shall be paid by the Secretary's draft on the Treasurer, O K'd by the President.

3. The meetings of the Society shall be devoted only to Horticultural topics, from scientific and practical standpoints, and the Presiding Officer shall rule out of order all motions, resolutions and discussions tending to commit the Society to partisan politics or mercantile ventures.

4. All patron and life membership dues and all donations, unless otherwise specified, shall be invested by the Treasurer in United States bonds. Only the interest on these bonds shall be available for payment of the current expenses of the Society. Perennial membership dues shall be placed on deposit at interest by the Treasurer. Only two dollars and the interest from each perennial membership fee shall be available for use in payment of the current expenses of the Society during any particular year.

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Dade, L. T., Ft. Pierce.
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HORTICULTURAL SOCIETY
QUARTERLY

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Thirty-Eighth Annual Meeting of the Florida State Horticultural Society

The year of 1925 has been a remarkable year in the history of Florida. It has been marked by a great influx of people into the state and by activity in buying and selling of real estate. In reality it is the beginning of a transition stage from an Old to a New Florida. With the completion of miles and miles of new paved roads opening up the State, even home folks have begun to see the beauties and advantages that are theirs and to appreciate their values.

Thus far the development has been largely in the cities. Thousands of acres have been added to their areas. Millions of dollars have been spent upon improvements, and development has been limited only by the ability of the transportation lines to bring in supplies.

The development of the country areas is yet in its infancy. In their expansion, the cities have taken large acreages of older bearing citrus groves and cut them into home sites. The new plantings to compensate for this loss, are just starting.

The cities have required large amounts of labor for their work. The farmer has had to sacrifice for this work. The acreages planted to vegetables, strawberries and other crops have been limited to that which he could care for with the limited amount of labor available.

In the New Florida, Agriculture is to have a very important place. Fruit growing is to be more extensive and new crops will be developed and grown commercially. Diversified farming will help to place the vegetable and animal industries on a safe basis. The various agencies in the State—the Department of Agriculture, the Marketing Bureau, the College of Agriculture, The Agricultural Experiment Station, the State Plant Board, the State Chamber of Commerce and the Realtors of the State—have a great responsibility. Each is to have an important part in this development work.

During near half a century, the Florida State Horticultural Society has an important part in the development of every phase of the Horticultural industry in Florida. Its published Proceedings is a history of Florida horticulture from its early days, through the critical years of 1894-1895, to the present time. Its pages tell of trials, vicissitudes and triumphs, that are inspiring. The meeting of the Society is a clearing house for horticultural ideas. It is a place where the growers come, meet, become acquainted, exchange ideas, correct misimpressions and show up misrepresentations. It is here that the mass idea is formed that leads through to bigger things.

In the development of horticulture in the New Florida, the Florida State Horticultural Society has a greater responsi-

bility than ever. Its members must appreciate this responsibility and prepare themselves and the Society to meet it.

The Thirty Eighth Annual Meeting of this Society was held in Eustis—a citrus and grape center—situated in one of the prettiest locations in Florida. There was a large attendance and much interest. The wide range of subjects discussed and their importance to the industry will be evident to the reader of this book.

Index to Proceedings

Like most Societies, this organization is in need of and deserves a larger membership. It needs more money to do its work effectively. The Secretary has in hand the manuscript of an index of the printed Proceedings of this Society from the beginning of its publication to and including the year 1924, which will be invaluable to the reader who wishes to get collective information on any one subject concerning Florida horticulture. It is quite lengthy, filling more than 150 typewritten pages. It required months of hard laborious work on the part of Miss Eleanor G. Shaw of the College of Agriculture at Gainesville, to prepare it. It was a work of love on her part and the Society is under very great obligation to her for preparing it. Unfortunately the Society does not have sufficient funds for its publication in this Proceedings, but the Secretary hopes to be able to publish it either as a supplement to this Proceedings and to distribute it in the Spring of 1926, or as a part of the 1926 Proceedings.

The 1926 meeting is scheduled to be held in Cocoa, Florida. While the date for the meeting has not been named, it probably will be held early in May.

PROCEEDINGS OF THE

Florida State Horticultural Society

THIRTY-EIGHTH ANNUAL MEETING

EUSTIS, APRIL 7, 8 AND 9,

1925

OPENING

Pres. L. B. Skinner: The hour has more than arrived to call the Thirty-eighth Annual Meeting of the Florida State Horticultural Society to order. Dr. S. H. Moore, of Eustis, will give the Invocation.

Dr. S. H. Moore: Invocation.

ADDRESS OF WELCOME

Hon. Henry W. Bishop, Mayor of Eustis

Mr. President, Members of the Horticultural Society, Ladies and Gentlemen:

As we are to listen to a number of other speakers this evening, and knowing that I am at home, I decided to welcome the Horticultural Society in a very few words, and I am reminded of the Western Senator, who was traveling in the South. Along after dark, he and his companion stopped at a tavern; after hollering and bringing the man of the house out, they asked if they could stay all night. He said, "Wall—I guess if you can stand it, I can." He went into the house, and after a supper of corn-bread, bacon and greens, he noticed that there was only one bed in the tavern, and only one room. There was he and his friend, the man and his wife, and about six children. As soon as supper was over, the people promptly put the two youngest children to bed. After these children were asleep, they were taken out and put over in the corner on the floor. This was continued until all the children were abed on the floor. Then they said to the Senator and his friend, "You can go to bed now," and the Senator and his friend were so tired they went to bed, and

promptly went to sleep, thinking that the hospitality extended to them was great. In the morning when they woke up, they found that they were with the children on the floor, and the man and his wife had the bed. It was southern hospitality.

Now we will give you all that we have; you can have the best that we have, and we hope you will enjoy it. You are welcome.

RESPONSE

H. Harold Hume, Glen St. Mary

Mr. President, Mr. Mayor, and Members of the Horticultural Society:

Personally, I am very glad that the conditions in Eustis are not those in the Mayor's story, because I have no feeling tonight myself for sleeping on the floor, and I guess a great many of the rest of you are in the same fix.

Mr. Mayor, we thank you for your words of welcome. We appreciate them. This Society has a feeling, however, that it ought to be welcome anywhere in Florida. It has been welcomed in a great many towns, welcomed by a great many people, and we have come to feel that we are a part of wherever we are. We are not strangers in any nook or corner of Florida. This old Horticultural Society, Mr. Mayor, has been in existence for a long time—thirty-eight years. It has tradition behind it—tradition for usefulness, for doing the things, or helping to do the things which have been worth while in the State. It has its present activities along these lines. Perhaps the greatest service which it has rendered to the State of Florida has been that of a clearing house for the discussion of the troubles which confront us from time to time, and those troubles, Mr. Mayor, are never the same from year to year, and the old troubles are never settled, because the things in Horticulture—the things with which we deal, are never finished. We may think we have reached the end of a problem—that it's settled, but we never get quite there.

Perhaps some of you have heard me say that in dealing with society, most of the things are not so anyway. Wherever you touch life in any of its phases, that is more or less true; when we think we have arrived at a definite state, we are then only on the brink or curve, which brings new leads of thought and action. When we think we have finished with a problem—that the thing is solved—that we are through, the old one has a way of cropping up from time to time, and always we have to go over the same ground, perhaps in part, to thresh out and get hold of a new line of thought, and a new line which leads us to do something else than that which we have been doing.

Mr. Mayor, let me say this for the Society—that we are especially glad to get into this section of the State. Florida is in a very peculiar state at the present time. I am not going to refer to the real estate and suburban developments at all,

but they have a part in our present upheaval. You have those real estate people here, I suppose, as elsewhere, and I might say to you, Mr. Mayor, if there are any real estate people in this audience, or around in town, please don't let them know this Horticultural Society is convening here, because our President might have a difficult time in carrying on the work which he has in mind for us in the next few days.

One of the things that impressed me very much in this part of the State was the fact that these roads had a different look. Some parts of the road over which we ran today (I covered upwards of 225 miles by getting lost in part to get here) —part of the roads had all of the trees labeled. Now when I go into a park or botanical garden, I always look to see the names, so I may know where they come from, and what they are, and I thought it was very kind of some people today that they had the trees labeled like this, but I noticed when I got down here those things weren't so plentiful. I missed the tree they call "666," and I missed the tree "Peruna." I missed the tree they call "Coco-Cola," and I gave thanks that one Willis Powell lived down in this part of the country at one time. Willis Powell has left his mark in this part of the country, and I hope to goodness that the mark may never be effaced. Many other Counties and many other parts of the State are trying to emulate the very good example of civic righteousness, so far as roadsides are concerned, that was set by Willis Powell, and I hope that those of you who remain will take up and keep up the work that Willis Powell started.

Mr. Mayor, we are very glad to be with you. We expect to have a very enjoyable time in the next few days, and we want you and your friends, in and around this part of the country, to join with us.

President's Annual Address

L. B. SKINNER, Tampa

Uppermost in the minds of all the growers of citrus fruits and especially the growers of grapefruit, and the one question every grower is asking himself, is, "What shall we do to be saved?" What can we do to remedy the troubles, What can we do to make the growing of grapefruit profitable?

We are beset with enemies on all sides; we are confronted, no matter which way we turn, with a regular Chinese wall that is a serious bar to our further progress or development; a wall erected by the Railroads; a freight barrier; a real hazard, a burden we no longer think right to carry, which we must overcome before we succeed.

The new Citrus Aphid is a serious menace. The Citrus Canker situation, while most encouraging, is still a very serious menace hanging over us, but the wonderful work done by Prof. Newell and his loyal corps of helpers, the Citrus Canker Crew, has made us feel comparatively safe. I gladly add my testimony to the work done by D. C. Gillett and his assisting committeemen in Washington, especially by Mr. Gillett, to whom the State owes a debt for his performance that we should never forget.

But we don't want to do any celebrating as we want to spend our energy in stamping out Citrus Canker every time it appears. There was none found in 1924. *BUT* in 1925 there *has been a few trees found and destroyed* and the territory in the immediate vicinity is being scoured and inspected in order that no guilty tree escape. If we can enjoy any feeling of security, we can do so only because our Mr. Newell is alive to our danger from a possible outbreak, and our Governor has manifested his purpose to provide means for the eradication of any menace to the State's greatest industry and asset—the Citrus Industry.

The new menace, the Citrus Aphid, which has spread over our State with unparalleled rapidity and destructive force, making our efforts seem puny and ineffective, has got to be met and solved—one more great expense—one more trouble. One grower expressed himself thus, "If I have got to fight this every year, I would rather dig up my trees and throw them over the fence."

The State Experiment Station had no money to work on the solution of this problem and Professors Watson and De Busk appealed to me as head of your Society, saying that something had to be done to get money to carry on. I called in Mr. B. L. Hamner and we decided to appeal to the Governor—tell him the necessity of action and ask him to make money available from the State's emer-

gency fund. I am glad to say the Governor immediately responded and work that we hope will be effective is being done as a result, and I want, here, to thank the Governor for his prompt action making this possible, and B. L. Hamner for his services in bringing it about.

We are always confronted with a bad situation in reference to means of fighting Aphids and White Fly and Scale.

We have another man to whom the growers of Florida owe a debt of gratitude.

Some expert government men are secretive about their work, about what they know (for they fear they may make a mistake perhaps). Once in a while we find a man in Government employ who realizes in an extraordinary degree his obligations to the growers and their problems are his. He has the courage to risk a mistake, and if he finds something that the people should know, he is ready to tell it, in a hurry to let it be known. We have such a man among us. He has done most valuable work for us; his oil insecticides are wonderful and what is more, they are cheaper than any other method and most effective. That man is W. W. Yothers, beloved by all growers of Florida.

In fighting the dreaded Aphids on young trees the most efficient and cheapest methods is to dip the infested twig in oil, but to fight successfully these twigs may have to be dipped often and too much oil will kill the twigs and you are as bad off as ever. This situation has been met and now we can dip in an oil emulsion indefinitely without harm by using an emulsion of Nujol or similar oil and kill the aphids and not hurt the tree, and W. W. Yothers has some interesting experiments he can tell you about. Ask Yothers!

Other methods will be brought out in the discussion which will be devoted to this subject, by Prof. Watson and his able assistant, Mr. Beyer.

We, all alike, rebel at the thought of admitting for a moment that the market has reached the point of saturation.

We know the markets are glutted and fruit for the past two years has brought nothing. But we also know that the consumers of the country are far from acting like gluttons as grapefruit eaters, or even as orange eaters. We know that if all the oranges and grapefruit were placed in a huge pile and every man, woman and child in the United States walked up and took only one at a time, that there would be only one a week for each person, or one orange every ten days, or only one bite of grapefruit a week. Think of these millions starving for oranges and grapefruit and they don't know it. We know that every man, woman and child in the country should have at least one orange and one grapefruit a day—a daily dozen might be better, but they are surely entitled to one a day of this "Fountain of Youth."

Right here I want to mention a new force which has started working in our behalf. The force of real cooperation as evidenced by the work of the Fruitmens Club, which has started to regulate the movement and whose work has culminated in the advertising campaign based on the promotion of the consumption of our product. People don't eat a

brand, they eat grapefruit, and the immediate success of this recent movement to advertise our product—grapefruit—to my mind conclusively proves the practical working of the program to advertise the product as a united industry and then follow up with the advertising of the brand. A tremendous step in advance has been taken. The way is plainly before us. We have got to make up our minds to spend some real money and *let us be sure* our money all goes into advertising, that the force of it all reaches the consumer, and that none of it is consumed in administrative work.

But having grown our fruit we are confronted with our antiquated, out of date system of freight rates, made when the industry produced a few hundred thousand boxes—today we produce fruit by the millions of boxes and our system of freight rates no longer fosters the industry, but instead spreads its baneful, blighting, effect over us so that every man, woman and child in the State is adversely affected and interested in getting it made right. "What can we do to be saved from this evil?"

The Growers & Shippers League of Florida—an organization representing 85% of the fruit of the State has undertaken this job. They first approached the Railroads for an amicable settlement. The Railroads, *while admitting the justice of our claims,* refused absolutely to give us any relief and practically said "you have your recourse to the courts" "we refuse to give you any relief—get it if you can."

The Growers of Florida accepted the challenge. The Growers & Shippers League of Florida then engaged the best talent they could get, and for nearly two long years they have been working hard, spending much time in the preparation of this case, and we have been ably assisted and advised by the Railroad Commission of the State and its able attorney, Senator Calkins, and the final complaint to the Interstate Commerce Commission has been completed and filed for a hearing. Let us hope we get the relief we are entitled to. The work so far has been well done, working in conjunction with Mr. Robinson who will address you later. The Traffic Departments of the Florida Citrus Exchange and Chase and Company and the Standard Growers and the American Fruit Growers, Inc., and others, have had a large part in the preparation of this work.

Wrapped up in the problem of more economical production is the problem of getting rid of our non-bearing trees, and the problem of more desirable varieties. We want 100% production in our groves instead of 25% or 30%, as it is now. Every informed grower will find this statement to be true if he will take a tree performance record of his grove. We want the best oranges we can grow—this is the pineapple; we want an early pineapple and a late pineapple. I am convinced these are already in the State. We want an early and a later variety of Dancy Tangerine. We want the man who can find them to come and help us. That man is A. D. Shamel, of the U. S. Dept. of Agriculture, now in California and Hawaii, where he has been for years and years. He is very anxious to come here. We need him. He has done wonderful

things for California and Hawaii. He can do wonderful things for Florida. The Department of Agriculture should do this for us. It is our turn, lets get him. Go after him through the Department at Washington. His work in California is about completed. It is Florida's opportunity to get the world's greatest authority on this work. Don't let this session go by until steps to accomplish this are taken. We can do it. A resolution will later be prepared and a committee appointed to undertake this.

We can't all grow oranges, but we can all boost Florida and fill her full of people who will thank us all their lives for bringing them here. We have the whole 150 million people of the United States to draw from—over forty states as a back country. Make Florida beautiful. Nature has been lavish. We can do our part and there will be profit and pleasure and long life to the millions who are headed our way. The world has found the path to our door and many there be who are traveling Floridawards.

Tell the world Florida is the real Sunniland of these United States "Summertime all the time," where it is summer in winter, where the true Fountain of Youth is found in its juicy sweet oranges and grapefruit, which, with its sunshine prolong the lives and make this life really worthwhile. Florida sunshine means life.

We should devote our time to beautifying Florida, the playground of the nation. Florida, at once a national necessity and a national luxury.

The Personality Phase of the Food-Production Problem

L. H. BAILEY, Ithaca, N. Y.

It is not now popular to discuss food-production problems. We are full in the epoch of marketing and transportation discussions; this is to be the agricultural contribution of this generation. Yet this is not a fundamental contribution to our welfare, for marketing does not exist as a problem unless there is adequate production. It is of course evident that the returns from production are not adequate in the main, the people are not properly served with produce, and the War stimulated production at the same time that it interfered with distribution and markets. We must have relief from these conditions, however temporary they may be; and the faulty marketing situations must be met and corrected.

We are taking renewed note of the hypothesis of Malthus, that population tends always to outrun production, for population increases in a geometrical ratio and sustenance mostly in an arithmetical ratio. Industrialism has stimulated the increase of population. Prosperity calls for more workers in all directions. We are so near the saturation point in population in the older and best developed countries that we are even discussing the regulation of it. The problem, then, is, how can we produce sufficient sustenance?

We may need fewer men, in proportion, to produce the sustenance, but the production must ever increase nevertheless, even though there may be emergencies in which some products are over-produced or at least under-marketed. We begin to foresee the time when every available acre shall be utilized to its full, notwithstanding the enormous areas that still are practically untouched.

Whatever may be the problems of this particular day, the great future of agriculture (and therefore of country life) lies in energetic production of supplies for food, shelter, clothing and the arts. And industrious production is what makes the farmer a farmer and it also makes him a man. Agriculture is still based on the soil, and not on any philosophy of political protest or social unrest and dissatisfaction.

We are so consumed in these days in statistics, figures, graphs, and incidents that we cannot get far enough away from our problems to see them. We are in danger of substituting statistics for observation.

The remedies for our agricultural distresses lie very little in direct legislation. Commissions may suggest reliefs, but the difficulties lie in the constitution of affairs; and such affairs change slowly

and only as a result of public understanding and conviction. The fundamental weakness of the constituted affairs of our day is that they are founded on economics, as if gain and loss in property were the essential concern of aspiring humanity. This is specially true of agriculture which is a phase of life and not alone a business, and which in its nature is charged with responsibility to the future. The exploitation and rape of the earth is essentially unmoral. Rewards in the future will be the results of a man's industry, labor and excellence. The man's product will be the measure of his worth; we shall eventually measure this product in a new kind of money founded on energy expended (not on hours consumed) and not represented by the fortuitous supply of a metal that is itself a commodity in the market, even as we measure mechanical energy by a horsepower. We shall not unduly tax personal production and we shall allow for the depreciation of capital represented in loss of fertility and inventory. We shall prevent speculation, that a few persons may profit thereby. We must find better means of regulating the operation of the "law" of supply and demand. In the end the execution of supply-and-demand in any particular case rests on the judgment or desire of a few men; often it is interpreted as if it were only a law of demand or a law of supply. We may deplore the existence of farm blocs, but we must remember that we have been controlled by a bloc, represented in commerce and tariff, and one bloc is as fair as another.

The farmer is the keeper of the earth and his dominion primarily is of necessity in the realm of moral responsibility rather than of economics or of what we now call social betterment. We are coming to be governed by organizations, resulting in a new kind of politics; we witness something like a recrudescence of medieval guilds. The farmer must make a good living; but if society is to prosper, if we are to have a proper care for those who come after us, and if we are to develop a resourceful civilization of the open spaces, then the only salvation of the farmer is that he shall make a willing moral contribution in the handling of the land and the supplying of the native needs of the people. All public agencies should encourage him to this end, and make his effort worth the while of educated high quality men. The time has passed when farmers exist only that they may "feed the world." Civilization cannot maintain itself if the care of the soil is to be relegated to cheap men. If farming settles into the small contentions of so many of the industries, we shall face disaster; for the fundamental consideration of mankind is to keep the earth fit.

The Past Season's Results With Crotalaria as a Cover Crop and Some Plans for Future Work

W. E. Stokes, Florida Agricultural Experiment Station, Gainesville.

The many benefits, direct and indirect, to be derived from a valuable cover and green manure crop are already well known to this audience.

Last year at your annual meeting I talked briefly about the new cover crop, Crotalaria, attempting to give something of the history, description, culture, advantages and disadvantages of the crop.

During the past year we have attempted to gather as much information as possible on the behavior of Crotalaria in various parts of the State. Through the influence of newspaper articles calling attention to the plant, about 160 grove owners scattered throughout the State wrote to the Experiment Station for seed in order that they might try the crop in a small way. We attempted to furnish these interested people with seed. The accompanying table will give you an idea of where the crop was tried out, how many finally reported, and how well they succeeded in growing Crotalaria the first time.

WHERE CROTALARIA WAS TRIED AND FIRST YEAR'S RESULTS.

County	Failures	Success	Total No. of Tests
Alachua	2	4	6
Bay	1	0	1
Brevard	1	2	3
Broward	0	1	1
Clay	0	1	1
Dade	1	1	2
Duval	0	1	1
Hardee	0	1	1
Holmes	0	1	1
Hillsboro	2	3	5
Jefferson	0	2	2
Lake	0	7	7
Lee	2	4	6
Manatee	2	0	2
Marion	2	1	3
Okaloosa	0	1	1
Pasco	0	6	6
Palm Beach	1	0	1
Putnam	0	2	2
Orange	0	3	3
Osceola	0	1	1
Seminole	2	1	3
Sarasota	2	1	3
Pinellas	2	2	4
Polk	2	5	7
St. Lucie	1	5	6
Volusia	1	3	4
*Walton	1	1	2
	25	59	84
Per cent	30	70	

Total No. of counties, 28.

*—One did not plant.

From this table we see that a total of 84 people in 28 counties made final reports to us. Of this number 59 persons, or 70%, reported favorably and 25 persons, or 30% reported unfavorably. What the 70-odd people who received seed and failed to report on them did, I wish we could say.

Since the odds seem in favor of Crotalaria, we think it is at least worth trying until it is definitely proven valuable or not valuable. More especially since 70% reporting got good results the first season from plantings made on widely varying soils, over a variety of planting dates ranging from March until July.

Several co-operators got a good growth on newly cleared land, indicating that Crotalaria might be a valuable crop for bringing new land into shape for future crops.

Most failures reported seemed due to poor germination of seed. Many reported a very slow growth until rather late in the season. Some reported Crotalaria as not making as good growth as the commonly used grove cover crops, while many reported Crotalaria making the best growth of any cover crop tried.

In general, plantings made from Gainesville north after June 30th matured no seed because of killing frost in November. This indicates that for the part of the State north of Marion county, spring and early summer planting is probably best, at least until the land is thoroughly seeded to the crop.

From Lake county south very little trouble has been experienced in producing seed abundantiy, except in a few instances where some insect was reported as doing injury to the seed crop.

Several men who co-operated with us in the matter of planting and reporting on the small quantity of seed which we sent them, in addition bought seed and planted a large acreage, and these men have in every instance, I believe, sold all of their surplus Crotalaria seed for planting this season.

EXPERIMENTS AT GAINESVILLE

During the past season we planned and put into effect a cover crop experiment on the grounds of the Experiment Station at Gainesville. The soil on which this experiment is being conducted is what is known locally as high pine land, classed by the Bureau of Soils, U. S. D. A., as Norfolk sand, fair citrus land, but out of the citrus belt. The experiment is so planned and conducted that we can determine the amount of green material and dry material produced by a crop of Crotalaria as compared to green and dry material produced by cowpeas, bunch velvet beans, and beggarweed, total pounds of nitrogen turned back to the soil from each crop and the value of this turned back material as measured by a crop of corn and of sweet potatoes the following season.

This season has given us information on the yield of the various crops and the amount of nitrogen turned back to the soil. The yields of air dried material are given for each crop in Table No. 2.

TABLE NO. 2

Tons air Dry Material per Acre.

Crop	Tops	Roots	Total
Crotalaria	2.187	.409	2.596
Cowpeas	1.318	.170	1.448
Beggarweed	.433	.187	.620
Bunch Velvet Beans	.914	.063	.977

Table No. 2 shows that Crotalaria has out-yielded all other crops under the conditions of this experiment. This, however, is the result of only one season, so too much importance should not be attached to it.

Through the courtesy of the chemical department of the Florida Experiment Station, working in co-operation with us on this experiment, we give you Table No. 3, which shows the average nitrogen determination of four samples of each crop. Analyses were run in duplicate.

TABLE NO. 3

Per Cent of Nitrogen in Four Leguminous Crops.

Crops	Per Cent of Nitrogen in* Tops	Roots	Both
Crotalaria	2.78	.92	1.850
Cowpeas	2.29	1.65	1.970
Beggarweed	1.64	1.07	1.355
Bunch Velvet Beans	2.51	1.48	1.995

*Dry basis.

From Tables 2 and 3 we are able to get Table No. 4, which gives the amount of nitrogen turned back to the soil by each crop. Granting of course that only about two-thirds of this nitrogen is derived from the air by nitrogen fixing bacteria.

TABLE NO. 4

Pounds of Nitrogen per acre returned to the soil by four leguminous crops and their equivalents in Ammonia and common Nitrate of Soda.*

Crop	Lbs. Nitrogen returned	Lbs. Ammonia returned	Equivalent in lbs. of Nitrate of Soda analyzing 18 per cent NH_3
Crotalaria	85.67	104.00	577
Cowpeas	51.35	62.34	346
Beggarweed	15.13	18.37	102
Bunch Velvet Beans	35.07	42.57	236

*N x 1.214=Ammonia.
NH_3 x .8235=Nitrogen

Chemical analyses of the Experiment Station this past season are in line with their previous analyses, which show a higher percentage of nitrogen in the top growth of Crotalaria than in the top growth of cowpeas, velvet beans or beggarweed.

The chemical analyses of roots of the four legumes show a lower nitrogen content for Crotalaria than for any of the others, but on account of the much heavier total yield of Crotalaria the total nitrogen returned to the soil is apparently much the greatest. Extreme accuracy has not been attained in this preliminary experiment, but differences are great enough to note and we believe they are significant.

Preliminary date of seeding and depth of seeding test was conducted at the Experiment Station the past season. Indications are that in the latitude of Gainesville, on Norfolk sandy soil, plantings made after the latter part of June will not mature much if any seed before killing frosts the latter part of November.

Best stands were obtained where seed were covered an inch or two deep. Plantings four inches and deeper, failed to give a stand.

The results to date seem to warrant us in doing further investigational work with Crotalaria, hence we have planned and started a cover crop experiment at Lake Alfred on the grounds of the Citrus Experiment Station. The land is high rolling pine land of the Norfolk series, cleared in 1923, planted to a cover crop of velvet beans in 1924, and planted to Pineapple oranges on rough lemon stock in January, 1925, trees set 25x25 feet. Trees were a uniform lot, calipering ¾ inch. The grove has been divided into 13

quarter-acre blocks, sixteen trees to the block. A composite soil sample, representing nine borings at three depths, 8, 16 and 24 inches has been taken from each quarter-acre block for mechanical and chemical analyses to determine the soil type, detect variations from block to block and to give us an idea of the chemical analysis of the different blocks at the varying depths to start with.

Two blocks will be planted to Crotalaria, two to cowpeas, two to bunch velvet beans and two to beggarweed, and five blocks left unplanted to any cover crop. Two of the unplanted blocks will be clean cultivated throughout the year and three given the regular cultivation until regular cultivation ceases and then let come what will in the middles. Our idea is to fertilize all blocks alike, take measurements of tree growth, get data on quantity and quality of fruit produced, determine the quantity of dry material produced by each cover crop and composition of it, make soil moisture determinations in the blocks from time to time and get any other information it is possible for us to obtain with means at our disposal.

So far as we know an experiment of this kind has not heretofore been conducted in the citrus belt. It seems as though the work is fundamental and we hope it will aid us in attempting to solve at least a few of our problems of economical production. We realize that the space allotted for this work is inadequate but it was a case of using what we had. Any criticisms or suggestions from this body with reference to any of this work will be appreciated.

Q. From one place in your paper it appears that cowpeas and velvet beans carried more nitrogen. Here you show them with less.

Mr. Stokes: That is due to the fact that there was a much heavier yield.

Q. The yields mentioned are per acre?

Mr. Stokes: They are, figured on the yields we obtained per acre last season, and calculated from the chemical analysis.

Mr. Whidden: The previous diagram shows the amount of nitrogen taken from the soil. Is there anything to indicate the amount of nitrogen which comes from the air, and that from the soil?

Mr. Stokes: This diagram gives you the total nitrogen.

Mr. Whidden: Where did it come from?

Mr. Stokes: About two-thirds comes from the air, and one-third from the soil.

Mr. Whidden: I appreciate the totals; I appreciate the value and the chemical analysis; I appreciate the mulch or humus that accrues to the soil from those crops, but that's not all there is to the proposition by a good deal. I am just a common Florida cracker; I am not a technical man, but I have been at this business all my life—in fact 50 years—since I was a boy. My father was a believer in soil building. He experimented with everything that came along, sometimes very much to his sorrow. It was often an expensive proposition. I am following the

same line, though I have been trying to be more conservative than he was. Now I would like to give you my experience in brief.

Last year I planted an ounce or two of the Crotalaria in my orange grove. It is new property. I wanted to see it grow. I grew a row of Crotalaria 30 or 40 feet long between my orange trees. In August there were more stink bugs to the square inch on it than I could count; there were five varieties on it. They were as healthy specimens as I ever saw anywhere. They were feasting on that stuff; they sucked the twigs, and the pods, and they just kept sucking them. They kept multiplying until that row was nothing but a swarm of the five varieties of stink bugs. I stood there and watched them every day, to see if a new species would come and join the congregation.

I diagramed it. I had an acre of Crotalaria, and I had 449,000,000 individuals of that variety of stink bugs, and if we had had a frost the 10th or 15th of November there would have been enough stink bugs there to eat up 13,000 boxes of fine fruit in ten days, or put it on the ground. I have seen that done with my own eyes in '75. Now then, the chemical part of it is all right. The soil building is all right, but can we take the risk for the work?

Mr. Stokes: Prof. Watson discussed that point, I believe, at the last annual meeting; perhaps he will give us something now.

Prof. Watson: What he says about stink bugs is true. There are a number of varieties, but my experience has been that in a normal season they will not attack the oranges. I have seen crotalaria within two inches of tangerines. They like the fertilizer pretty well. In an ordinary season the crotalaria is not a danger to the tangerines, but an insurance. The plant bugs stay on the crotalaria and do not move to the tangerines. There is a possible danger that about every 25 years we might have an early frost, but if you are really afraid of that it can be prevented by cutting the crotalaria the latter part of the summer. There are not very many pumpkin bugs on crotalaria. Ordinarily if we have a frost hard enough to kill the crotalaria it will kill the pumpkin bugs.

Mr. Whidden: Now just a word more. I watched this experiment that I conducted last year, and by the last ten days of August, I thought I had made enough observation to satisfy me and I dug up my crotalaria, but not until I had killed every one of those bugs. Now, if Mr. Watson will take the weather bureau record, and read it, he will see that we have frosts oftener than 25 years, and early enough to kill crotalaria, but not sufficient to kill the bug, and in ten days afterward there will not be a single orange on the tree. I have seen this with my own eyes. If we can persuade the weather man to put off the frost, the bugs like the crotalaria better than the orange trees. They are not especially partial to any brand of fruit when it is necessary to eat it.

Prof. Watson: In a case where there is any danger of crotalaria being killed by frost, it would be very easy to get in there with a very strong insecticide and kill the

crotalaria—kerosene for instance. They would not leave the crotalaria for a day or two after the frost, and it would be possible to spray with insecticide. I don't believe the danger is quite as strong as you think.

Q. Wouldn't a frost of 28 degrees which would kill the crotalaria kill the pumpkin bugs crop?

Prof. Watson: It wouldn't kill them, but if it came very early in the season, the pumpkin bugs might die without very strong insecticide.

Mr. Stokes: We have one or two men that have been growing this crop for several years in their groves, and one or two of them are attending the meeting here, and they could perhaps give us some valuable information on the crop. While there are undoubtedly some dangers attached to it, we are just attempting to give you here the data that we have collected from the past season, and we haven't really drawn any conclusion to my paper. I am going to leave that with you to do. We propose to carry the work a little further, and to find out a little more about it, if we can.

W. L. Drew: There is one other feature about the crotalaria that has worried me, and it also is connected with the pumpkin bug. I don't think I am interested in crotalaria as a cover crop unless it will reseed itself. If you cut it before it seeds at all in order to escape the danger of the pumpkin bug, there is no re-seeding. I grew some, experimentally, in a grove at Eagle Lake this year, and it was covered with pumpkin bugs. I never saw the like. I saw them for the first time, and I wondered what to do. The time came when I would like to cut it down for my regular operations. I wanted to fertilize. I says: "I can't cut that crotalaria down—there is great danger with all those pumpkin bugs," so I turned the men in there at once to fertilize. That stuff stood there until late in the winter before I dared do anything with it. It's a nuisance in that way.

We made cuttings along about the time it began to bloom and obtained a good second growth, and where our frost of 28 degrees hasn't come too early in the Fall, have gotten a good crop of seed. Perhaps Mr. LaRoach of Merritt's Island could give us some of his experience with the plant for the last seven or eight years. I believe if you are really interested Mr. LaRoach wouldn't mind answering some of your questions in regard to his experience with the plant. We don't want to advocate anything that will give serious trouble, but since we have gotten some interesting figures on the plant, and some of the grove owners have been using it with good results, it looks to us as though it is worth trying until we find definitely whether we can use it advantageously or not. If you will ask Mr. LaRoach some questions he will answer them, and give you correct information, because he has been growing the plants for a number of years.

Mr. Skinner: Mr. LaRoach, what has been your experience?

Mr. LaRoach: I have never lost any fruit.

Mr. Skinner: Have you ever had any frosts on Merritts Island?

Mr. LaRoach: We have never had

much killing frost and I haven't had much trouble with pumpkin bugs.

Member: Are they there?

Mr. LaRoach: A few.

Member: But you let the crotalaria stay there a year?

Mr. LaRoach: Yes.

Member: Do you cut it down while the pumpkin bugs are on it?

Mr. LaRoach: Yes.

Mr. Skinner: What's the quality of your fruit?

Mr. LaRoach: Pretty good.

Mr. Stokes: Here is a proposition that is running in my mind. You have been in the grape section. You know what the soil is. Take it in a young grove. Wouldn't it be a good proposition if you could grow some plant in there, while your trees are young and not bearing much that would so fill your soil with organic matter and nitrogen that when the trees came to bearing the soil would be in better shape, and then if you didn't use the cover crop after that to amount to anything, wouldn't you have gained?

Mr. LaRoach: Yes. I do that. I have tried all these weeds, and they all raise bugs. I don't say for you to do what I have done, but I have gone back to one thing—working the farm. There is nothing equal to natal grass. When it gets about that high I just cut it off, and leave it on top of the ground. I have a piece of land—I thought it was the poorest dirt that I ever saw, except sand scrub; it looks very much like that. It was so white it would hurt your eyes. I introduced that natal grass on it, and now it's rich and prolific. That's all they have in the way of mulch. There was a mulch man in the grove not long ago. He took the soil up and said, "This soil is so dark —so fine." I said, "That's natal grass ground up there." That's my experience.

Mr. Skinner: Mr. LaRoach, how did you get rid of your crotalaria?

Mr. L. D. Williams: I can answer Mr. Skinner's question. I live next to Mr. LaRoach, and it was due to the good looks of his grove that I got some seed from him. I have gotten rid of the cover crop several different ways. When it is young I mow with a common mowing machine. When it grows—I will have some about 7 or 8 feet high—when it has plenty of room it branches out. I ran a heavy tractor over it, and it all dies. When it's tall and you mash it over, every bit of it dies. You can run back the other way, and it goes right into the soil. As for pumpkin bugs, I don't know about those. I have never heard anyone make complaint about pumpkin bugs on the East coast; probably they have natural enemies or something there; I don't know about that, but in a place where the pumpkin bugs don't bother you especially, in a young grove, or any old trees where you just follow the mulching system, I think crotalaria would help.

Cover Crops in High Pine Soil

F. M. O'Byrne.

Due to a crop failure cowpea and beggarweed seed is higher this year than it has been for many years past. It is therefore a good time to take stock of the situation and ask ourselves the question, "Will it pay at prevailing prices to plant a cover crop this year?" Some people have answered, "No," when they have heard the prices of seed. Even at the present prices it will cost but a dollar and a half or two dollars an acre more than usual to plant a leguminous cover crop. Is it possible that the returns from a cover crop are so slight and uncertain as to make an increase in cost of two dollars an acre grounds for discontinuing its use? Most emphatically, no! In the speaker's opinion there are other causes at the bottom of such decisions, chief of which is a failure to think the matter through clearly.

There are some people who will state their reasons quite clearly at once, as for example, the man who said, "Don't say cover crop to me. I had a splendid cover crop in my grove and it brought on the worst case of die-back I ever had." He was honest in his opinion, but oh, how far he missed it! A cover crop never brought on a case of die-back; it was failure on the grower's part to use the crop properly that caused the trouble. If one turns a heavy crop under green he may expect trouble, or if he makes no allowance for the cover crop when he fertilizes he can expect die-back eventually. A cover crop planted in rows is sometimes given excessive cultivation to start it well, with unsatisfactory results. Some cut the cover crop for hay and appear to think that they are benefiting the soil by removing the hay and the humus-impoverished soil may bring on die-back. A cover crop properly handled never brings on die-back.

"I planted a cover crop in my grove one year and the pumpkin bugs just ruined my fruit," a second grower may say. This could have been prevented by the proper cutting of the cover crop at the right time. A leguminous cover crop infested with pumpkin bugs should be cut not later than the middle of September before the pumpkin bugs develop wings. A man with a scythe should go through the grove first, cutting around the trees, and between them. This will drive the pumpkin bugs into the middles which should be cut last. The chances of a wingless pumpkin bug finding its way to the trunk of the tree are remote. Some leave a narrow strip of cover crop down the extreme middle to be mowed several days after the first mowing. The mowing must be thoroughly done to prevent trouble. Some very practical and successful growers mow the cover crop early in September and then send in a large num-

ber of hoe hands at once to hoe it from around the trees. This is a good practical method providing one gets the hoeing done at once, but will mean trouble if one lets other work crowd out the hoeing. You will generally find that the man who is blaming the cover crop for his pumpkin bug trouble was careless about mowing it properly and at the proper time.

But by far the greatest majority of those who do not intend to plant a cover crop take the position that *that* is one cost they can dodge or that they hadn't figured on it or they pass the matter off as if it were of no importance. My sympathies are with the man who wants to keep the expenses of his grove down to the minimum. But to economize by saving the cost of a cover crop is to be "penny wise but pound foolish." The man who can see the dollar on the other side of the dime will certainly plant a cover crop.

When our secretary, B. F. Floyd, came back from California recently, he told a friend that the citrus grove practice which impressed him the most was the use of large quantities of bean straw as a fertilizer and soil builder in the groves. If this is advisable in California how much more important is it here, particularly on our high sand soil.

Volunteer cover crops are generally of poor quality. Natal grass is by far the most common. It makes a rather sparse vegetable growth and does not shade the ground. Soil on which the cover crop is natal grass dries out quickly from wind and sun and does not build up rapidly when the crop is plowed under. Maiden cane is worse. Some natural cover crops are somewhat better but are generally found on our heavier soils. But the leguminous cover crops lead all others as soil builders because they alone have power to take nitrogen from the air and fix it in the soil. Roughly it is figured that two-thirds of the value of a leguminous cover crop is above the ground, and one-third below. This explains why the owner of a grove is up against a very practical problem if he has a large number of animals to feed. It seems foolish to buy hay at $40 per ton when there is a lot of it up in the grove for the gathering. Generally a small part of the hay will suffice. If the hay is merely passed through the animal and returned to the grove as manure the loss is relatively small. Some growers make hay from one cutting one way and leave the cutting the other way and all the second cutting in the grove. The point to be thoroughly understood is that no soil is built up by cover crops if hay is regularly removed and used.

Between five and ten tons of leguminous cover crop can be grown on one acre; more of some things. Of this, one to two tons will be dry matter and four to eight tons will be water. How much will a ton of any other organic fertilizing material cost you? "There is no way in which such a large amount of organic matter can be added to the soil so cheaply——." I know of a 20-acre two-year-old grove which had a heavy crop of beggarweed plowed under last fall. It needed no fertilizer this spring, a saving to the grower of at least seventy dollars in fertilizer besides the cost of applying it. Surely this grower did not begrudge the cost of the cover crop. Moreover, that was not the only saving, for the benefits derived from

a cover crop are accumulative, lasting over from year to year.

When I made out a budget for the estimated cost of producing my grove I made provisions for planting a cover crop every year for the first five years. I wonder how many include such an item in their estimates? I figured that I was justified, for thus building up the soil would save on fertilizers later on and would enable me to produce a better grade of fruit.

One point that many growers overlook is the fact that the time to build up the soil with legumes is while the trees are small. At that time one can plant all of the ground except a narrow strip on each side of the trees, and plowing or other cultivation of the crop will not hurt the young tree's roots. Each year the tree will encroach more and more on the area which one can plant to a cover crop until in time very little of the land is available. If one expects to build up his soil with a legume he should start early and put in his best licks while the trees are yet young.

The three legumes most commonly used in our groves in the past have been velvet beans, cowpeas and beggarweed. Velvet beans have not gained wide popularity for three reasons. First, They do best when planted in rows and cultivated at first. This cultivation is expensive and burns out a good deal of humus before the vines are able to shade the ground. Second, The vining beans are a nuisance because they run all over the tree almost over night. Third, Their value is largely destroyed by the velvet bean caterpillar.

The cowpea has long been a favorite, particularly the Brabham, because of its resistance to rootknot and because it makes large quantities of vine. Unfortunately, it does not re-seed itself. In a wet spring best results can be had by planting in March but more often cowpeas are planted in May, just before the rains set in. One-half to one bushel per acre of peas are used and in a young grove they should be plowed in lightly. In a larger grove they can be disked in, though the stand is not apt to be as good as if they are plowed under.

Beggarweed has been a favorite for many years. It is sometimes quite difficult to start on our sand hills. This may be due in some cases to poor seed. Only good fresh seed should be used. It's also a good plan to inoculate it by mixing it with an equal quantity of sand from a grove having a good stand of beggarweed. Some growers say they get better results with beggarweed by growing cowpeas in the grove a year or two and then planting beggarweed. If you have tried to get a stand of beggarweed unsuccessfully and feel sure your seed was all right try a crop of cowpeas and then plant beggarweed the next year. Beggarweed seed does not all sprout the first year. Some remain over for the second and even for the third year. Care should be taken not to continue the spring cultivation too long for this is an easy way to kill the beggarweed crop. Beggarweed is still our standard cover crop in citrus groves.

There is a new contender in the field for cover crop honors, Crotalaria. I planted fifteen acres of it in my grove

last year and reserved five acres in which I planted cowpeas and beggarweed for the comparison. This year I am planting the other five in Crotalaria. Need I say more as to my opinion of it? We still have to work out the problem as to how best to handle it to keep it from becoming too coarse. I plan to cut it as soon as it starts to blossom and let it stool out and come up again to produce a seed crop. This will keep the stems fine enough to cut. Prof. Drew tells me that he cut his down last year and that it came back in splendid shape. He can't say as much for the beggarweed that he cut down about the same time. I can say for Crotalaria that it will make a prodigious growth in the sand hills on what we consider very light land. It serves as a trap crop for pumpkin bugs, re-seeds itself, requires no inoculation or cultivation and will grow on new or old land. It looks very promising.

Without further argument let me say that I urge the planting of legumes in young groves as a summer cover crop for the following reasons:

1st. They build up the humus content of the soil. A large humus content makes for quality fruit.

2nd. They increase the water holding capacity of the soil.

3rd. They save fertilizers.

4th. They make the fertilizer used act more satisfactorily, reducing the danger of fertilizer injury.

5th. They shade the ground from the sun, thus saving water and humus.

6th. They conserve soluble plant food.

7th. They benefit soil bacteria.

8th. Their benefits are accumulative and lasting. Plant them while the grove is young, handle them properly and you will always be glad you did so.

Member: Is there any danger of putting too much nitrogen in your soil by the cover crop?

Mr. O'Byrne: I think not the slightest in the world.

Member: I have a grove two years old that I fertilized heavily; some of the trees are six feet high, and had die-back.

Mr. O'Byrne: I would like to get out through your grove. I think working the cover crop in while too green or excessive plowing is apt to bring it on. You want to do just as little plowing as you can. You want to get it plowed under. In traveling around through the groves I have never seen a grove where the die-back is due to the cover crop. I think it is usually due to the way the grove has been handled in the past.

Member: It may be my own fault. I may have, in the Fall, turned it under when it was too green, or I may have plowed it too deep.

Mr. O'Byrne: Excessive cultivation will bring it on.

Member: The pumpkin bugs not only hurt the oranges but I have caught them sucking the stem of the tree.

Mr. O'Byrne: We found them on young succulent growth.

Member: This was on the old stock.

Mr. J. G. Atherton: I think any man that has a grove should begin when it is young, to raise all the cover crops possible in that grove. I have been in the business twelve years, and the first thing I do is to grow some legume cover crop and cut it once or twice a year, and let it decay. As far as getting die-back from nitrogen in the soil, it depends on the grove location. I have two groves, one flat and level, the other on a slope. Both have had the same amount of beggarweed. In the one on the slope there is die-back, but it comes from seepage areas.

Cover Crops and Soil Building in the Citrus Grove

W. L. Drew, Eagle Lake.

I haven't written out what I have to say today, and I have some notes to guide me a little. The subject is "Bermuda Grass as a Cover Crop—an Incomplete Experiment."

I am one of the victims of what I think is a false practice of cultivation. (That was in vogue at the time when I started in, in this business)—that is keeping your Acme harrow going all the time, or very frequently after you fertilize in the Spring until it's time to turn the grove over to the cover crop, and that I practiced religiously. The result was that I cultivated too frequently and sometimes too late, and in consequence the cover crop became less and less, and sparse, and sometimes there was very little of it. The consequence of that was that the humus was worked out of the soil, and we had an infertile soil.

The block of trees that I am going to speak of just now are Valencia trees on rough lemon root, near Eagle Lake. The trees had begun to french slightly for want of humus. They had never been limed, but the appearance of things was a good deal the same as if they had been. Three years ago, finding this condition, we put stable manure on this block of trees early in June, starting, I think, the last of May, and ending early in June. There was very little seed of any natal grasses in the soil, and I hoped that the stable manure might introduce such seed. But this manure came in from Tampa in car lots, and was hot when it arrived, and I think the seeds were nearly all killed, for after we worked the manure in, and the rains came, I discovered the seeds were not coming up, and that I was likely to have a repetition of no cover crop that season. After some investigation, in desperation I planted Bermuda grass, in this grove, where this stable manure had been applied. It came rather slowly that first year. It nearly all lived, but it didn't make a rapid growth. There was a little crab grass, and sandspur found its way in, and re-seeded the land, to some extent. At the end of that year, in December, we plowed this grove. We plowed the Bermuda grass under, believing it might stimulate the grass and cause it to come up better. That's about the end of the first year. At this time our fruit was inclined to be coarse, greenish, and what did turn a good yellow before it was time to harvest held late, and would have a tendency to go back green again and dry.

Many of you are familiar with that character of fruit in the rough lemon root groves in this condition. The second year we fertilized in February and disked this fertilizer in on most of this area, but we reserved about six rows upon the hill, where the Bermuda had been planted first, and was more prominent, with the

idea that we would see what it would do not to cultivate, and from that time to this that land has not been disturbed. The Bermuda has been allowed to grow, has been cut from time to time, and the fertilizer has been thrown upon the ground and allowed to get down in as best it could. The rest of it we disked in, harrowed once, with a spike-tooth harrow —no other cultivation.

It was fertilized again in May on the cover crop, and not worked in at all, on any part of this grove. My idea was to divide the summer fertilizer that year. I fertilized twice, in order to get as much cover crop as I could, because we were growing orange trees and trying to grow fruit, and not Bermuda grass primarily, and because we got a good stand of cover crop of the natal grasses that year, the question was whether we should work that land for Bermuda grass, or take what was in hand, and get as good a cover crop as we could. We decided to let the Bermuda grass fight it out. Consequently we got a pretty good cover crop and the Bermuda had a hard time.

We fertilized again in August—no cultivation. We fertilized again in November and disked part of that in, all except this reserved part. Now the fruit that year was much improved. It turned good color, and it was marketable fruit. It, however, was pretty large. We fertilized perhaps rather heavily, using two applications in the Summer, and it may be that we got fruit that was larger than I liked. The trees were in good condition—neither frenched nor starved.

That brings us up to the third year. This year we fertilized in March, disked in the part we were accustomed to disk, and not the other. Fertilized in May, disked again, and this time, because we had gotten too large fruit the year before, we went probably to the other extreme, and we used in March a 3-8-7, half organic, and in May a 2-8-10, half organic. Before the end of the season, along late in Summer, these trees showed a distinct hunger, and late in the Summer, in September, we put on some more fertilizer, only spot fertilizing, where there wasn't very much Bermuda grass, but more and regularly, where the Bermuda was thicker.

I am trying to tell you just what happened—both good and bad. This year our fruit is very much better; in fact, it is a different quality of fruit. I see a good deal, however, as I look around in groves, that have been handled differently, that looks pretty well this year, in the way of Valencias—well colored, no drying, no coarseness, nothing very large—some of it is smaller than I like to see. On the other hand, the trees do not look vigorous. They have been too much starved; their foliage is sparse, especially in those regions where there has been no cultivation at all. Where we have been disking once, and stopped there, we got better growth, better tree condition, and not quite so good fruit. But where we have left the cover crop alone, the Bermuda alone, without any interference at all except the mowing, the trees got very hungry, didn't look good at all to me, though the fruit was first-rate. Now at the present time that fruit is dead-ripe—riper than it ought to be in that Bermuda block—some Anthracnose showing, some spotting of

the fruit. They are not vigorous now, and it's going to mean some little difference has got to be made if we continue to use Bermuda as a cover crop.

One thing that probably has accentuated this matter—we used the fertilizer in November, and after that there was no rain until two months had elapsed, and nothing to carry the fertilizer down. The fertilizer itself was of rather a insoluble form, and the two things didn't work well together.

So far as the Spring bloom is concerned on this grove I have been speaking of, the bloom did not come at one time, as I like to see it. The trees have not grown as rapidly as I like to see them grow in the Spring. I haven't fertilized in the Spring, as we don't want to ruin our fruit by fertilizing Valencia trees untill the fruit is practically out of the way, but with no rain it wouldn't have made a bit of difference. The bloom has been coming along for a long time; it's coming now; it and the aphis are having a good time together. If you want to fight the aphis you want your bloom to come and get out of the way, but to have it come and stay with you is particularly difficult, with the aphis.

I went to visit a grove a few days ago, owned by Mr. R. Addison, near Loughman, and I was well repaid by what I saw there. It's a grove of only seven acres—old-style homestead. It is on high pine land, not so very different from what I am familiar with. I should think—possibly a little heavier. Bermuda has been in that grove, practically undisturbed, for fifteen years. It's a heavy Bermuda sod, thick on the ground. The trees were in excellent condition, showed no starvation, no hunger; the finest crop was set for this year that I have seen as yet unless it may be grape fruit, and grape fruit hasn't shown very much tendency where I have observed to set a crop of fruit this year, generally, so far, but his orange trees are full of young fruit. I did not see the crop that was taken off. It was taken off before I got to the grove. He reported that it was very fine quality. He has a number of Satsuma trees on grape fruit root growing in that Bermuda. He shipped the fruit from the Davenport house, and it netted him $3.00 a box this year on the tree. I inquired about his method of fertilizing. He fertilized four times a year, using 4-8-4 each time, 4% ammonia each time. The amount of his potash seems light. The amount of his ammonia would be destructive in fertilizing groves I am familiar with, treated as they are ordinarily treated. The fertilizer is almost all in organic, so it is soluble. The amount he said he used seemed quite small to me. He uses about 8 tons to seven acres during the year—a little over a ton to the acre, including the four applications, but he has succeeded apparently in accomplishing two very desirable things. He gets a good quality of fruit, but he leaves his trees in a condition where they are ready to bear again, and apparently do bear heavily; at least they are doing so this year, and so on the whole I am quite hopeful of the Bermuda Experiment in a bearing grove, although I don't regard my success in my own grove as at all unqualified.

Member: Was the grove budded?

Mr. Drew: It's a budded grove; some seedling trees.

Member: What average box quantity might they run?

Mr. Drew: I couldn't tell you.

Member: There is question in my mind whether it wouldn't be cheaper to fertilize the ground for the trees than for the Bermuda. What was the age of those trees?

Mr. Drew: Those trees were set out thirty years ago; some of them are younger.

Member: In fertilizing that Bermuda do you believe that the fertilizer has been largely inorganic?

Mr. Drew: I believe I would have been more successful with a more soluble fertilizer.

Member: I am strongly in favor of using the cover crop. Another thing has ocurred to me; Do you believe by planting crotolaria in with the Bermuda you would have any better success.

Mr. Drew I wonder if I could make the Bermuda grow there?

Member: Probably so.

Mr. Drew: I don't know anything about mixing crotolaria with other cover crops.

Member: I have seen some of that tried. It eradicates Bermuda grass.

Mr. Warner: My grove is about 45 years old, partly sweet stock, some sour stock and a few rough lemon. For a good many years I tried to get rid of Bermuda grass, and I found it a practical impossibility. In spots we permitted it to increase and remain undisturbed. About 15 or 18 years ago I ceased cultivation on those particular spots. On one of them in particular, where I have had the Bermuda grass growing about eight years, we had difficulty in growing good trees; the sand was white sand right down with no other sub-soil. Since we have permitted the Bermuda grass to grow there, it has formed a heavy sod. Those trees have improved wonderfully, and where I have had it growing nearest, my trees look the best. It forms a heavy sod which we never even hoe. In case of cold weather Bermuda grass is killed. It is very combustible, and we hoe fire rows, but where we have had that Bermuda grass growing longest we have our best trees. They bear regularly, and there has been very little dropping at any time of the year.

There are other localities in the grove where I have no Bermuda grass, and I think the benefit from non-cultivation has been less there than where the Bermuda grass is. We have natal grasses growing there, and they form a good cover crop.

In fertilization we use entirely inorganic material with a pretty good amount of ammonia. Last year we used 5-10-8. We do not use any great quantity—perhaps a ton to the acre during the year, and I think the trees that we have not cultivated and have Bermuda grass show a better condition in every way than the trees that we have cultivated and have no Bermuda grass. We have the benefit of irrigation, and perhaps that has been one source of our success.

Observations on Citrus Wilt

Arthur S. Rhoads, Cocoa Laboratory of the Florida Agricultural Experiment Station.

INTRODUCTION

Citrus wilt, dry-wilt, leaf-curl, or blight, as this disease has been variously termed, is a trouble peculiar to citrus trees that has been known in Florida for approximately 50 years. It is also reported to occur in Cuba but is reported on good authority not to occur in California. While commonly alluded to as blight, the speaker personally prefers the term wilt, which is more descriptive of the trouble under discussion than the term blight, which is one applied to most any more or less rapid dying back of plants.

The first reliable account of citrus wilt was published in 1891 by L. M. Underwood. A few years later, in 1896, Swingle and Webber published a more detailed account of it based on their personal studies. At that time wilt or blight was regarded as one of the most destructive diseases of citrus in Florida, the annual loss to growers being estimated by Swingle and Webber in 1895 at from $100,000 to $200,000 annually. Since the freeze of 1894-95, which wiped out many of the groves more or less severely attacked by wilt and which caused the center of the citrus industry to swing farther south, wilt has made its appearance in many of the newer grove areas. Today it occupies the same position as regards destructiveness as it did before the freeze and, with the tremendous increase of the citrus acreage, the total annual loss from this trouble is unquestionably much greater. Probably no more striking example of the heavy toll taken by citrus wilt can be cited than certain groves in Brevard County, where this trouble appears to be exceptionally severe, which have lost as high as one-third of the original stand of trees as a result of wilt, and more are steadily contracting the trouble. Not only does wilt destroy thousands of fine bearing trees annually but the necessity for removing and replacing these trees, in addition to proving costly practice, destroys the uniformity and beauty of the grove and results in having trees of mixed ages, all of which greatly detracts from the market value of the groves.

After several years of agitation by various members of this society, the U. S. Department of Agriculture began an investigation of citrus wilt, or blight as it was then called, in 1891. Unfortunately, however, before any definite results could be obtained, the disastrous freeze of 1894-95 resulted in the abandonment of work on this problem. No concerted effort was made to further investigate this much dreaded trouble until within

the past two years, when this was rendered possible by the initiative of Mr. A. B. Michael, regional vice-president of the American Fruit Growers' Association, supported by funds contributed by this organization for the work and supplemented by additional funds contributed by your experiment station and the county commissioners of Brevard County.

Within the past two years much valuable investigational work has also been done independently on the problem of citrus wilt from the standpoint of the soil moisture relations by Mr. A. O. Kay, drainage engineer of the U. S. Department of Agriculture.

In the brief time allotted to me I can merely dwell upon the most salient features of the problems of citrus wilt as they relate to the investigations in progress and the results thus far obtained.

DESCRIPTION OF CITRUS WILT

Citrus wilt is usually reported to occur on trees that previously appeared perfectly healthy and in good bearing condition. In its typical form on trees that have been well cared for and fertilized sufficiently so that they are not dying back from other causes which complicate matters, wilt is usually readily recognizable to a person at all familiar with it. As a rule it starts very gradually with definite symptoms which may be overlooked by the casual observer until the trouble has progressed to a point where a tree exhibits a well-advanced case. Many growers claim that wilt attacks their trees literally over night but, according to the speaker's experience, this is a sure sign that they have not had their trees under very frequent, or at least very close, observation. In some instances, however, the wilted leaves may have dropped, the affected branches died and the conditions be such that no further wilting and curling of the foliage be evident at the time of inspection, in which case the trouble may escape detection.

A gradual wilting, drooping and curling of a portion of the foliage, as if the trees were suffering from drought, is the first visible indication of the disease. It may be noted in passing that many trees often exhibit a slight general wilting of the foliage after the crop has been picked, but this appears to be but temporary and not a forerunner of the so-called blight. As a rule the wilting of the foliage is very gradual and may be noticeable at first only on warm days. In the incipient stages the foliage of affected branches may appear more or less normal early in the morning but after the day warms up the leaves rapidly wilt and curl, this being most striking about the middle of the afternoon. The foliage may continue to alternately wilt and revive in this manner for several weeks. Ultimately, however, the wilted foliage revives less freely until a chronic or permanent wilted condition sets in, after which the under sides of the wilted and curled leaves are clearly visible when looking at a tree.

With the progress of the wilt in any one branch or part of the tree the foliage continues to curl more and more. After generous rainfall it usually revives to a greater or less extent temporarily, but within a few days again exhibits the former curled condition. Eventually the occurrence of rain fails to revive the foliage

even temporarily. The curling of the foliage progresses until sooner or later, depending upon the soil moisture and the atmospheric conditions, the foliage on the affected branches turns a sickly yellow, dries up and drops off, the blade of the leaf usually falling first and the petiole soon thereafter. The leaves drop first from the twigs and smaller branches and slowly but surely the whole limb dries up and dies as a rule. If the tree happens to be bearing at this time the fruit on the defoliated branches stands out in striking fashion. If the affected branches do not die too soon or too rapidly the fruit may color up but remains small in size and acid in taste. As a rule, however, if the wilt starts sufficiently early in the season, the affected branches die so early that the fruit withers up and drops off before reaching maturity.

Often branches bearing considerable fruit that appeared perfectly healthy in the early or middle part of the summer will become completely defoliated by October or November, the wood dying and the fruit dropping before it is mature. Even though the branches may not dry up until in December or January the fruit is inclined to drop off easily after it begins to loose its turgor. Where but a few branches on a tree are affected by wilt the branches that remain healthy may concontinue to bear fruit although usually, as a result of the general devitalized condition of the tree, this remains small and below commercial size. Eventually the green color of the defoliated branches is lost and they turn brown, shrivel and become dry and dead, drying out progressively backward from the terminal portion. After their death such branches show up in very striking fashion throughout the crown of the tree. When once attacked by wilt the decline of the tree usually continues more or less rapidly and the proportion of dead branches becomes greater each year until the tree no longer bears enough fruit to render its further retention profitable.

In some cases progressing more slowly, branches that become wilted and defoliated in the fall and winter do not die until after defoliation but put forth a new growth of leaves rather late in the spring. This new growth of foliage that develops on the wilted limbs of such trees that die back only partially, with the exception of the water-sprouts, is always small and undersized as a result of the general devitalized condition of the tree. Wilted trees in general average several weeks behind healthy trees in putting forth their new growth in the spring. They also present a great range of variation in the degree to which they put forth new growth. Some exhibit a strong tendency to develop an abnormally heavy bloom late in the season, in which case the bloom, together with the young leaves on many of the branches, soon wither and die, as do the overtaxed branches later. In other cases a more or less vigorous, but usually rather sparse, new growth of shoots is developed on the defoliated branches that failed to die but the foliage developed on these shoots remains small and usually also exhibits more or less curl sooner or later. As they become older such leaves acquire a dingy green color and constitute one of the characteristics symptoms of wilt in its slower form. Wilted trees

are further characterized by a tendency to bloom irregularly, sometimes as early as December in case they are almost done for, but ordinarily after the regular blooming period is over.

Wilt is very capricious in its development and may manifest itself in many diverse ways. Most frequently the trouble appears on a single branch or the divisions of a branch, usually, but by no means always, at the base of the crown. By the time the foliage on the initial limb or limbs to become affected exhibits a marked curling and dropping that on the adjacent branches on the same side of the tree usually exhibits the trouble and eventually the whole tree becomes involved regardless of whether the first branches to become affected were pruned off or not. It frequently happens that the branches on one side of the tree may show a decided wilting and curling of the foliage for a long time before that on the other side exhibits any sign of the trouble. Occasionally a single large scaffold limb or a single trunk of a tree may show a marked wilting and curling of the foliage whereas the rest of the scaffold limbs or trunks of the tree may remain perfectly healthy for several months or even a year afterward. Occasionally the foliage of the entire tree will acquire a wilted condition more or less simultaneously throughout the crown but usually the disease progresses irregularly, one branch or the branches on one side exhibiting the disease before the rest of the crown. In especially rapid cases of wilt the affected branches may dry up so quickly that the leaves will curl up tightly, become pallid and remain more or less strongly adherent for a time, giving these branches much the appearance of having been scorched by fire.

After from half to two-thirds of the crown has died as a result of wilt the affected trees invariably develop a more or less dense growth of watersprouts from the base of the trunk and in the interior from the scaffold limbs. These grow vigorously for a time, since a considerable portion of the crown has died and has thereby lessened the demand upon the root system, but eventually wilt and curl like the rest of the foliage, although they are the last part of the crown to die. Contrary to the opinion commonly expressed by many growers, the development of watersprouts is not regarded by the speaker as necessarily an indication of wilt since their development is a normal tendency of practically all hardwood trees greatly weakened from various causes. Trees in the late stages of decline, where the crown has largely died and more or less numerous watersprouts remain, usually do not exhibit much wilting and curling of the foliage by virtue of the fact that the top of the tree has been so greatly reduced as to make but little demand upon the root system. When trees have reached such a stage it is often hard to say whether they have died from wilt or some other cause.

Ordinarily wilted trees continue to decline more or less rapidly until within a few weeks or months, or even a year or two, they are either virtually dead or worthless commercially. In such cases, especially with trees on the better types of soils, or when cut back severely, a wilted tree may continue to linger along for

several years, making a slow, sickly growth and producing a small amount of fruit. Trees appreciably affected by wilt rarely ever recover unless favorable periods of rainfall intervene before the trouble has progressed too far and the conditions contributing to it do not reoccur for a period.

RELATION OF WILT TO KIND OF CITRUS TREE AND ROOTSTOCK

The trouble known as wilt or blight attacks practically all kinds and varieties of citrus trees grown commercially in the state, and regardless of rootstock. It occurs on various varieties of oranges, tangerines, mandarins, grapefruit, lemons, kumquats, and tangelos. It occurs on sweet seedling orange trees and in the case of trees budded on sweet seedling, rough lemon and sour orange stock. It may also occur on unbudded rough lemon and sour orange trees.

But little can be said concerning the relative susceptibility of the different kinds of citrus trees or rootstocks to wilt because only rarely do we get enough together in any great number on the same type of soil and under the same soil moisture conditions so that a comparison from this standpoint would be justifiable. With but few exceptions, there is not believed to be any marked difference shown by the different kinds of citrus trees and rootstocks to wilt. In the case of trees on sour orange root, however, the grapefruit appears to be somewhat less susceptible than the orange. Of the oranges on sour orange stock the pineapple appears to be the most susceptible, apparently by virtue of its tendency to bear heavy crops, while the Valencia appears to be the least susceptible, apparently by virtue of its more uniform and consistent habit of bearing.

RESULTS OF INVESTIGATIONS

The investigations on citrus wilt have been conducted from a number of different angles in the hope that some clue would be found to the nature of this obscure trouble. Since there was no visible indication of the occurrence of any fungus associated with the twigs, branches or trunks of wilted trees to account for their sudden decline, one of the first things attempted was a study of the root system of such trees for evidence of the presence of a causal organism or relation of the trouble to soil conditions. In the great majority of wilted trees excavated for study the roots exhibited no decay or discolorations whatsoever, being perfectly sound and with the bark green, except for an occasional dead root tip. These roots in general, however, were strikingly deficient in the fibrous feeding roots essential to the normal support of citrus trees and, in cases where the trees had exhibited a pronounced case of wilt for a long time, the wood was somewhat drier than it normally should be and appeared as though partially seasoned or cured. The occasional finding of a wilted tree with rotted roots is believed to be merely a coincidence and rotted roots are not considered to have any basic relation to the occurrence of wilt, especially as they occur frequently in the case of those on rough, lemon and sweet seedling rootstocks, which do not exhibit a wilted condition. It is clearly evident that the af-

fected trees die back by virtue of the failure of the roots to support the top rather than from any initial dying of the top itself. This explains why the removal of affected limbs does not arrest the progress of the disease and why a severe heading back of trees actually exhibiting the trouble known as wilt or blight, while often resulting in a temporary healthy growth for two or three years by virtue of greatly lessening the demand upon the root system, merely serves as a rule to retard the progress of the trouble for the time being. The cultures and microscopic studies thus far made fail to show the presence of a causal organism in the wood of either the roots, trunk or branches of wilted trees. In this connection it is of interest to note the statement made by Swingle and Webber that a thorough microscopic examination of various parts of wilted citrus trees failed to show the presence of a causal organism.

As an additional means of demonstrating whether citrus wilt is caused by an organism of whether it is merely a physiological trouble resulting possibly from certain soil or soil moisture conditions extensive experiments in budding and grafting trees were started in the spring of 1924. Several hundred buds have been made on young sour orange and a number of grafts have been made on older bearing orange and grapefruit trees. In all cases where the budwood was taken from wilted or blighted trees it was selected from the branches of typically affected trees on which the foliage exhibited a marked wilting and curling or had dropped off more or less completely. At one of the groves where these experiments were conducted 50 young sour orange trees were budded with budwood selected from the best pineapple orange trees available, this lot of budded trees serving as checks. If the trouble known as wilt or blight should be transmissible through budwood these experiments should clearly demonstrate this point.

Very poor success was had in many cases with both the buds and grafts. This was largely due to the necessity of selecting budwood from the poorest kind of trees with but little vitality and sap in the bark and that many of the trees available for this work were far from being first class nursery stock. Those trees in which the initial budding and grafting was unsuccessful were rebudded or regrafted until success was assured in most cases or the tree died in the case of the young trees deprived of their tops. In general it may be stated that a degree of success varying from poor to fair was had with the use of budwood from typical wilted trees, depending on the degree to which the vitality had become depleted and whether or not the nursery stock was in an active state of growth. Up to the present time the successfully budded trees have developed into as good a lot of trees as could be expected and practically all are sufficiently fine-appearing trees that anyone not acquainted with their pedigree would be glad to set them in their groves. At one grove where one row of about 50 trees were budded with budwood from variously typical wilted trees and the same number on an adjoining row were budded with budwood from healthy trees not exhibiting wilt, although

many in the former row were behind those of the check row in starting due to the necessity of rebudding, the growth made by the former row compares favorably in general with that made by the check row. Aside from the much higher mortality of the buds taken from the wilted trees and their greater tardiness in starting, but one point of difference was noted between them and the buds from healthy trees. This was the fact that a number of the buds from the wilted trees proved to be fruit buds which, upon developing, blossomed and, in a couple of instances, set fruit. This is probably attributable to a partial nitrogen starvation, resulting from the limitation of soil solute absorption by the root system, inducing fruit bud differentiation in the case of the wilted trees, which often bloom more or less profusely just before dying if their final decline comes anywhere within the range of a month or two before or a like period after the regular blooming period.

Fifty of the trees budded with budwood from typically wilted trees were set out in January, 1925, in one grove where many wilted trees have been removed and the underlying rock blasted this time preparatory to replanting. Unfortunately, however, this grove was sold recently and the trees may have to be moved in order to assure the continuance of the experiment. Plans are now being made to clear and set out about two acres of land as a test grove for the trees budded in this work, having rows of trees budded from healthy trees alternating with those budded from wilted ones. Since this is a long-time experiment which will require at least 10 years before conclusive results can be drawn with assurance, the portion of the grove devoted to this experiment will be leased for a sufficiently long period to assure the continuance of this experiment for the requisite time. In this connection it is of interest to note that the trees developed from budwood from wilted trees by Swingle and Webber had reached the age of three years before they were killed by the freeze of 1894-95, and were reported to be perfectly healthy up to that time. It seems probable that wilt is not transmissible by budding unless several years are required for the disease to make its appearance in the tree, which seems highly improbable.

A series of experiments has now been started in which the propagation of trees from portions of the root of wilted trees will be attempted in order to demonstrate whether or not this trouble may be transmitted by root cuttings.

This brings us to a consideration of the question of the age at which citrus trees develop wilt or blight. The minimum age at which trees develop this trouble is generally stated to be from 6 to 8 years after they have been set out in the groves, and usually not until they have reached the age of 10 or 12 years, when they have come into more or less full bearing. In fact the growers frequently complain that the wilt often takes their finest trees that have borne the largest crops of fruit. The latter statement is believed to have particular significance, as will be shown later.

It is a common sight to see young trees set out in the groves as replants wilt un-

til their leaves become curled so badly that they may drop and, in some cases, the trees may even die. It is true that the present practice of mounding the dirt about these trees tends to repel much of the scanty rainfall that might otherwise reach their roots but they often wilt from drought whether they are mounded or not, or even after the mounds have been torn down. Even nursery seedlings but a few months old may wilt at times. This wilting of the young trees, which is identical with that exhibited by the older bearing trees, is always attributed by growers to lack of sufficient moisture in the soil. This is beyond a doubt the correct diagnosis of this trouble for a generous application of water made about the base of the tree will almost invariably revive the wilted foliage of these young trees to its normal turgidity within 24 hours and one such application will usually hold the tree for the balance of the season unless extremely dry weather prevails. In occasional instances, where the wilting has been prolonged until the foliage is almost ready to drop, a second application of water may be required to fully revive them.

When older bearing trees wilt and die, however, the cause is practically never assigned to drought by the growers but is invariably regarded as being due to "blight." One can not help but wonder if this distinction is not a state of mind of the growers. When the grove soil admittedly becomes so dry that young trees wilt and even die as a result one certainly does not have to stretch his imagination very far to speculate as to the role of inadequate soil moisture in causing older bearing trees to wilt and die.

Bearing trees have much larger tops to support than young trees and, while they also have much larger root systems in proportion, they likewise frequently carry large crops of fruit which obviously make a heavy demand upon the available supply of soil moisture. Our citrus trees are induced to make a good vegetative growth during the rainy season of the summer and fall months and to develop the fruit which they have set, and then, as the crop approaches maturity, at a critical period when the bearing trees actually require more water than at any other period of the year, they receive far less by virtue of the advent of the dry season during the winter and spring months. That this situation exists in our citrus culture can not be denied.

It has been found that there is a definite correlation between the season of the year and the occurrence of wilt or blight and that the occurrence of this trouble and the rapidity with which it develops is directly related to the moisture content of the soil. Not only is wilt most strongly in evidence during the dry season of the year, but it is during this season of the year that virtually all new cases invariably develop and that trees affected by wilt decline the most rapidly. Trees in which the root systems have become injured during prolonged dry periods to such an extent that the tops exhibit an appreciable amount of wilt usually continue to exhibit the trouble more or less during the balance of the year.

While young trees may be revived by applications of water even after they have

exhibited a marked wilted condition for a considerable period, applications of water do not seem to arrest the progress of wilt in the case of the older bearing trees, where it has become unmistakably evident, until after a considerable portion of the tops have died. In these trees by the time the foliage exhibits an appreciable degree of wilting the root systems seem to have become injured to such an extent that they can not continue to support the large tops and often more or less heavy crops of fruit, even with the help of water. After a balance has been struck by the dying back of a portion of the top continued applications of water, however, do clearly retard the further decline of the trees by stimulating the development of new feeding roots, providing they have been begun in time and made so as to actually wet up the soil about the root system. The beginning of curl must therefore be regarded as the critical point in the life of the older bearing trees.

On the other hand, numerous trees that were definitely known to have had the root system more or less severely injured by an excessive amount of soil moisture following periods of unusually heavy rains have been observed to develop a marked wilting and curling of the foliage a few weeks after the root systems were so injured, in such cases where they were not killed outright. It is well known that where the roots have been thus injured by an excessive amount of water in the soil the tree may wilt as a result of drought even though the soil remains saturated for a long time. In those cases where water injury has occurred and the soil subsequently dries out to where the soil moisture content may become deficient, wilting of the foliage, even though not particularly evident before, may become very conspicuous. Not only does the wilt become greatly accentuated on the trees that showed the trouble shortly after the soil was saturated but it may develop on a number of the adjoining trees that at first showed no appreciable injury from excessive water. Growers very frequently fail to connect this wilting with the injury of the roots of the trees in question by the saturated condition of the soil occurring a few months before. As a result of water injury both young trees in nurseries and bearing trees of various ages may exhibit a more or less marked wilting and curling of the foliage which is absolutely indistinguishable from that exhibited by bearing trees that occur on well drained land. As a matter of fact such water-injured trees as exhibit a more or less marked wilting and curling of the foliage and decline slowly over a period of a few months are usually classed as blighted trees by growers. Where the water-injured trees decline rapidly they appear to diagnose the trouble correctly as a rule.

We thus have at least three distinct groups of trees exhibiting an identical wilting and curling of the foliage, namely, both young and old trees whose roots have been injured more or less severely by excessive soil moisture and which are suffering from drought induced indirectly, young trees that have not yet come into bearing and which are suffering from drought induced directly by a deficiency of soil moisture, and older bearing trees on land that never becomes too wet and

in which the trouble is not conceded to be due to drought by growers but popularly attributed to "blight." The evidence available indicates that the wilt exhibited by each of these three groups of trees is attributable to the same cause, namely drought, either directly or indirectly induced. If this be accepted it becomes evident that citrus trees may exhibit wilt at all ages from seedlings to old bearing trees.

Citrus wilt, which occurs at several widely scattered points in the state, is by no means uniformly distributed throughout the citrus section. The exact distribution of this trouble and its relation to soil types are points that will be investigated in detail shortly in a reconnaissance survey. In general it may be stated that wilt occurs most abundantly on the lighter, drier types of hammock soils, especially where underlaid by coquina rock, less abundantly on flatwoods and high pine land, and least abundantly in groves on either clayey hammock or typical low hammock land. These observations are in general accord with those made by Swingle and Webber in the early 1890's.

Observations thus far made indicate that wilt is probably of most widespread occurrence in Brevard County on the East Coast. Within the groves of this county wilt appears to be very definitely related to the soil type. Here it is of a very frequent occurrence in the narrow strip of groves bordering on the Indian River from a few miles north of Cocoa to below Bonaventure, and at the lower end of Merritt's Island, where the majority of the groves are located on high hammock land belonging to the Gainesville series, which, in this section of the state, is usually more or less closely underlaid by coquina rock of irregular distribution. On the other hand, the majority of the groves on Merritt's Island, with the exception of the extreme southern end, are located on soils of the Norfolk series and on scattered local areas of low hammock land comprising soils of other series. Groves on the soils of the Norfolk series and the low hammock land exhibit much less wilt than those on the soils of the Gainesville series and when trees do develop the trouble they decline much less rapidly on the former soils than on those of the Gainesville series. The great range of variation in the susceptibility of citrus trees to wilt on the different soil formations demonstrates a very definite and clean-cut relationship between the occurrence of this trouble and the water-holding capacity of the soil type. The close proximity of coquina rock in soils with a relatively low water-holding capacity, such as those of the Gainesville series, beyond a doubt is strongly conducive to the occurrence of wilt. Groves on such soils usually exhibit a high mortality from wilt after the trees have attained the age of from 12 to 14 years.

Based on general observations, there does not seem to be any doubt but that the soils of many of the groves in the vicinity of Cocoa which are deficient in organic matter often becomes too dry during the winter and spring months of the year to adequately maintain citrus trees. Where deficient in organic matter, as is frequently the case, when the soil once becomes dry it clearly repels

water and is very difficult to wet up again. The soils, but particularly those of the Gainesville series, are further characterized by the fact that there is but little lateral movement of water in the soil, the rainfall or irrigation water tending to seep down in places where the soil is loose or organic matter is present locally, with the result that the intervening areas tend to remain dry. In order to demonstrate this, one has but to make a basin about a tree and flood it with water. After such a basin has been flooded, for say half an hour, one can run his hand down beneath the water and bring up dry sand. Even after as heavy a rainfall as 5 inches in two consecutive days dry areas of soil can frequently be found in groves even close to the surface of the ground.

Growers frequently ask, if it is true that the soil in their groves does become inordinately dry, why it is that their trees do not exhibit wilt uniformly throughout the grove instead of irregularly through it. This can be explained only on the basis of local variations in the soil moisture content, the various soil types, the occurrence of underlying rock, and in the vitality of individual trees. Trees are frequently noted in many groves that have borne heavy crops of fruit and may be showing signs of inadequate fertilization, or may be in a weakened condition from various other causes. When the fertilizer is applied it is often done by inexperienced labor who distribute it more or less uniformly to all trees regardless of whether some need it more than others. It will thus be seen that there are several good reasons why the trees in a grove may succumb to wilt in an irregular manner.

It is not the purpose of the speaker, however, to dwell upon the soil moisture situation other than briefly in a general way. Mr. A. O. Kay of the U. S. Department of Agriculture, who has made a special study of the grove soils of Brevard County, correlating the rainfall and retention of the soil moisture by the different soil types with the occurrence and progress of the trouble known as wilt or blight, will address you next on this subject.

By no means all the dying of citrus trees can be attributed to wilt or blight, although many growers are prone to consider this the case. Early in the course of the speaker's work it became necessary to distinguish between trees dying from wilt and those dying from other causes, among which the most frequent on the East Coast are poor drainage augmented by excessive rainfall at varying intervals, root-rot, underlying coquina rock or marl, depletion of the organic matter in the soil, insufficient fertilization, miscellaneous haphazard grove practices, and plain neglect. Many of the groves in this section, in which the soil conditions are extremely variable even within local areas, have been planted on sites that are by no means ideal for groves of any great longevity and such groves will always prove a source of trouble and expense. Grove sites, in many cases at least, were picked out with but little or no consideration of the suitability of the soil to support a grove for any length of time. Unlike beauty, the criteria of a good grove are not

only skin deep. Nevertheless groves are still commonly bought on the strenght of the appearance of the tree tops, or on a mere superficial examination of the soil, especially by the northern man unfamiliar with the extreme range of variation exhibited by soils in many sections of the state as regards their potentialities for citrus growing. The desirability and the limiting factors of the different soil types in Florida for citrus groves and the recommended method of soil management for the more important types is an agronomical problem that could very profitably be given .considerable attention. Truly the maintenance and management of many of the groves established in Brevard County at least, and probably other counties as well, call for as much exercise of thought and attention as do either the control of diseases or insects, with the possible exception of the citrus aphis at present.

Since wilt was considered to be a contagious disease by Swingle and Webber from their investigations of this trouble in the early 1890's growers were advised as a matter of precaution that where a case of wilt occurred the affected tree should be removed promptly and burned on the spot, after which the hole could be filled up with fresh earth and replanted. While these investigators considered wilt to be a contagious disease, this point has never been demonstrated, they themselves admitting that a thorough examination of parts of wilted trees never disclosed the presence of a causal organism. After many years of setting out new trees in places where wilted ones have been removed it is quite evident that the new trees are not much more liable to die from wilt than trees set out on new land of the same type and then only after they have attained about the same age at which the trees that were removed succumbed. Of course if the supply of humus in the soil has been depleted or there occur a few seasons with less rainfall than usual the trees may develop wilt at a somewhat earlier age than they did before. This would indicate that wilt is not a contagious disease. A few growers still follow the practice of promptly removing trees as soon as they exhibit a well-defined case of wilt, but the majority of the growers retain their wilted trees as long as they continue to produce an appreciable amount of fruit and many do so even longer. In groves where wilt is inclined to occur, new cases appear to develop regardless of whether those that first exhibited the trouble were promptly removed or not.

The wilt or so-called "blight" of citrus trees is believed to be a physiological trouble caused primarily by irregularities of soil moisture conditions, chiefly from a deficiency in the amount of soil moisture available during the dry season of the year, rather than a disease in the usual sense of the word, that is, one caused by a pathogenic organism. There may not yet be sufficiently definite proof to stand the acid test of the scientific mind but the circumstantial evidence seems quite strong.

Granting that the problem is a physiological one, as appears to be the case, it is certain that no remedy will be found that will be inexpensive and quick and easy of application, these criteria con-

stituting the qualifications of a remedy in the minds of most growers. Citrus wilt appears to be a trouble whose control must be effected primarily by the application of preventive measures rather than of remedial measures after the trouble has made its appearance. It is believed to be entirely preventible by confining the planting of new groves to the more desirable types of soils and properly maintaining them according to correct practice. In groves already established on the less desirable types of soils it is believed that the occurrence of wilt can be greatly mitigated but by no means entirely prevented by the adoption of such cultural practices as contribute to the maintenance of an adequate supply of organic matter in the soil, the conservation of soil moisture during the dry season of the year, and avoidance of irregularities and extremes in the application of fertilizers. In this connection it is of interest to note that citrus wilt appears to be much less extensive in the ridge section of the central portion of the state, where the groves receive considerable cultivation, than in Brevard County, where they receive comparatively little attention. Since the rootstock used in these respective sections of the state are not comparable it is not known just how much significance can be attached to this observation. It is also of interest to note that in California, where irrigation is practiced by virtue of necessity, that the wilt or blight which we have in Florida and Cuba is said not to occur, although a somewhat anaolgous trouble, termed "windburning," has been reported recently. This is nothing more or less than dehydration of the leaves and twigs, brought about by the removal of water from the leaves at such a rapid rate and under such conditions that new supplies from the roots can not replenish the plant cells fast enough to prevent a complete breakdown of the living tissues. This trouble is induced by the action of dry, hot winds which occasionally sweep down from the desert. Windburning is most likely to occur in groves where the soil moisture has been allowed to actually reach the wilting point but may also occur in groves that have been over-irrigated.

The use of cover crops as a means of conserving the soil moisture in citrus groves is a practice which the speaker believes should be practiced vastly more than it now is. This practice is already much more extensively practiced in the ridge section of the central part of state than it is in the groves of Brevard County, where, with the exception of the use of Crotalaria in a few young groves, the native growth of spanish needles, sandspurs, teaweed, grasses, and other weeds is relied upon almost exclusively.

It is believed that irrigation would be of decided value in preventing wilt and a number of other troubles in the bargain in those groves where the type of soil does not retain moisture well during the dry season of the year. It is admitted, however, that most growers would consider the cost of irrigation plants prohibitive, at least on the strength of the prices obtained from the fruit the past two years.

In the ever-increasing tendency to plant more acreage to citrus trees some of us have lost sight of the fact that in the wild

state the edible species of citrus are usually found growing in partial shade, in hot, humid climates, on soils rich in organic matter and abundantly supplied with water from the heavy rainfall of those countries. It seems to the speaker that we are departing too widely from the natural habitat of the citrus tree, judging by some of the grove soils and soil conditions he has observed in a large number of cases, and that so long as we continue to digress so widely from the environment and requirements most favorable to the growth and development of citrus trees the greater will be our affliction from wilt and various other troubles. We do not need additional citrus acreage half as badly as we need more thought and foresight applied to the selection of the land on which the groves are established and in the proper maintenance of these groves after they are established.

In conclusion I will say that the opinions expressed represent those formulated on the strength of the observations made and the evidence obtained to date. They will be adhered to, by myself at least, until additional experimental work and observation can develop any other line of thought and belief regarding the nature and cause of citrus wilt that may seem to be supported in a more substantial manner.

Report on Soil Moisture Conditions in Brevard County, Florida

Albert O. Kay, Associate Drainage Engineer, United States Department of Agriculture.

An examination of the conditions in the citrus growing sections of Brevard County, particularly in the vicinity of Cocoa revealed the fact that the trees were suffering from a deficiency of moisture at certain seasons of the year, whereas at other times there were indications of excessive water. Following this examination investigations were begun to ascertain the soil moisture conditions in the groves during the year and the effectiveness of the rainfall in replenishing the soil moisture removed by evaporation and transpiration. There studies were commenced in July, 1923, and are still in progress.

Early in the investigations it was learned that at least 8 different soil types and 11 phases prevail in the areas planted to citrus, and that on all these types and phases the trees apparently suffered from either drought or excessive moisture, and that some trees were subjected to both extremes during the same year. In addition, wilting trees were in evidence on the two predominating soil types, Norfolk series, and the Gainesville series, of what might be termed the coquina phase (that is, underlaid with coquina rock). Soils of the Norfolk series are of the deep sand formation and occur principally on the higher or rolling land. The Gainesville soils are also on the relatively high land but underlaid at depths varying from 6 inches to 5 feet or more with an undulating rock platform and pitted with potholes.

The investigations disclosed wide variation in the amount of moisture in the soil. This condition obtained whether the subsoil was deep or shallow and underlaid with rock. At times there was less moisture in the fifth foot of soil than in the top six inches; and, again, there was less moisture in the second and third foot than in the first or fifth. It was not unusual to find running dry sand at any depth down to five feet—the depth to which the samples were obtained. It was first assumed that one set of samples taken at a tree would indicate an average moisture content around that tree. Such an assumption however, was unwarranted, since the variation in moisture content at the different locations under the tree was as great as the variations in any vertical section.

At first only one set of samples at each tree was taken, samples being taken for each foot of depth down to five feet. The number of samples was soon increased to twelve sets per tree taken at distances of from 4 to 10 feet from the trunk of the

tree. The samples were taken as follows: 0 to 6 inches, 6 inches to 12 inches, 12 to 24, 24 to 36, 36 to 48, and 48 to 57 inches, making six samples in the vertical and 72 samples in all from the tree.

Where there was an underlying rock or hardpan formation the samples were taken to such layer.

The following record will give some idea of the variation in moisture in the Norfolk soil; the samples were taken around a 20-year-old seedling orange tree having a spread of about 20 feet. In this set of samples the lowest moisture content in the vertical section varied from 1.9 per cent to 2.7 per cent, and appearing at any depth in the section, while the maximum moisture content varied from 3.1 per cent to 5.9 per cent. These are by no means the least or the greatest moisture content percentages found during the investigations, but merely represent a set of records taken at random to show conditions. A greater variation will be shown in this type of soil later.

SOIL MOISTURE, NORFOLK FINE SAND

Location from tree	Maximum per cent	Depth ft.	Minimum per cent	Depth ft.
5′ N	3.5	0.5	1.9	4th
8.5′ N	3.5	0.5	1.9	3rd
7.5′ N E	4.0	0.5	2.3	4th
5′ E	3.4	5.0	2.0	3rd
10′ E	4.9	0.5	2.3	2 & 3rd
7.5′ S E	4.9	0.5	2.4	2nd
5′ S	3.1	4.0	2.4	5th
8.5′ S	5.9	0.5	2.2	5th
7.5′ S W	3.3	5.0	2.0	3rd
5′ W	4.0	5.0	2.4	2nd
10′ W	3.3	0.5	2.7	2nd
7.5′ N W	4.1	0.5	2.3	2nd

Note—A complete record of one set of samples in the Norfolk fine sand soil is appended.

A set of soil samples taken in the Gainesville soils of the coquina phase will show even a greater variation. The following tabulation shows a record of a set taken about a tree where the depth to rock varied from 6 inches to more than 7 feet below the surface, and where potholes were common, as shown in the accompanying plan and sketch. (Fig. 1). The minimum moisture content under this tree varied from 1.35 per cent to 3.14 per cent; and occurred at different depths in the different sections. The maximum varied from 2.29 to 11.55 per cent. There was a variation in moisture content of from 1.35 per cent in the fourth foot at a point nine feet north of the trunk to a maximum of 11.55 per cent in the fifth foot section at a point 7.5 feet northeast of the trunk. Incidently, the point of maximum and minimum moisture contents are less than 5 feet apart.

SOIL MOISTURE GAINESVILLE SAND, COQUINA PHASE

Location from tree	Maximum per cent	Depth ft.	Minimum per cent	Depth ft.
5′ N	4.55	2	2.05	4th
9′ N	2.29	3	1.35	4th
7.5′ N E	11.55	5	2.66	0.5 to 1
5′ E	3.37	3	1.48	4th
9′ E	3.66	3	1.88	0.5
7.5′ S E	3.98	5	1.69	0.5 to 1
4.5′ S	6.93	5	2.24	0.5 & 4
9′ S	6.19		1.68	0.5 to 1
7.5′ S W	3.28	3	2.17	0.5 to 1
5′ W	4.41	0.5	3.14	4th
9′ W	5.18	4	2.69	2nd
7.5′ N W	3.87	5	1.74	0.5 to 1

Note—A complete record of one set of samples in the Gainesville sandy soil is appended.

Closely associated with the variable moisture condition of the soil is the difficulty of moistening the soil after it has dried out to the "running dry" stage. That a dry top soil is difficult to moisten is well known, but the slowness of re-

moistening the subsoil is a fact with which few are acquainted since it is generally supposed that the soil moisture increases with the depth of soil.

This investigation shows that under trees which are declining for reasons heretofore unknown, there are dry layers and dry lenses of soil. Roots present in these dry soil areas are subject to injury so long as the dry condition exists, regardless of the moisture content at any other point. In many cases dead, dry roots varying in size from feeding roots to those ¼-inch in diameter, and even larger, have been brought up in the soil samples. The following tabulation indicates, in a measure, the possible length of time necessary to replenish the moisture removed by the roots of the trees. The samples were taken at points 3 feet north and 3 feet south of a 4 year old pineapple orange tree set to replace a large seedling which had been removed after it had deteriorated to such a degree that it was no longer of commercial value.

	North side	South side
August 1, 1924		
Top 6 inches	9 per cent	8 per cent
5th foot	2 per cent	6 per cent
Following 8.5 inches of rain in July. Rain in August 2.2 inches.		
September 12		
Top 6 inches	4 per cent	5 per cent
5th foot	1.8 per cent	2.2 per cent
Rain in September 7.5 inches.		
October 13		
Top 6 inches	9.7 per cent	8.5 per cent
5th foot	6.3 per cent	6.3 per cent
Soil eventually uniformly wet after 19 inches of rain had fallen.		

These data show that although 8.5 inches of rain fell in July, there was a variable moisture content around the tree, and that not until 19 inches of rain had fallen during a period of 2½ months was there an approximately uniform moisture content. Since the rainy season of 1924 was prolonged it is not difficult to imagine the fate of this tree if a normal season had obtained. Another instance of the difficulty of moistening the soil in a grove was observed where an artesion well has been flowing for at least 18 months, yet dry sand was obtained at a depth of 2.5 feet below the surface at a point 5 feet from the stream. It might be thought that the character of the water had something to do with this but such is hardly the case since the same condition has been found following a series of rains and also where shallow well water has been applied by irrigation.

This raises the question—What becomes of the rain water that falls? Because of the tendency of the surface soil, when dry, to repel moisture, the water runs over the surface to a depression and then sinks to a depth beyond the reach of the roots of the tree. Many samples have been examined where a wet condition was found in one place and perhaps only 2 feet away dry sand was found. Even more extreme conditions have been found. Naturally, one would expect to find less moisture in the soil when roots are present than when they are not, but one would hardly expect to find dry sand and feeding roots within 6 inches of a moist area containing no roots.

This condition can be explained, when the characteristics of the soil are considered. In the Norfolk soils there is little or no chance to recover the water which sinks to the lower depths because few

feeding roots penetrate to any considerable depth and there is no impervious layer to check the downward movement of the water. Under this condition there can not be a saturation of the soils for a protracted period. In the Gainesville soils the underlying rock platform obstructs the downward movement of water, except through pot-holes and by very slow percolation through the rock. Considerable water is lost by reason of the water running over the surface to a depression (which may be only a few inches deep) and sinking in. If the depression is near a pot-hole then the excess water will go straight down. Some of these holes are deeper than 12 feet; others merely represent an undulation of the rock platform, and tend to serve as holding basins until slow seepage has permitted the water to disappear. Where the rock is close to the surface the soil dries out very rapidly, and there is no chance for replenishment except by rains and irrigation. When the water collects in basins in the rock if there are roots present they will be submerged and perhaps injured. Even with the downward movement of the water prevented by the rock, a lateral movement may also be prevented by the undulation of the rock. This undoubtedly is the explanation for the extreme moisture variation existing in the Gainesville soil record as previously shown. One instance was observed when irrigation water could not surmount rock barrier and spread laterally.

In the opinion of the speaker, the absence of general wilting (except at a dry time) in the clayey hammocks and prairies can be attributed to the presence of a more or less uniform clay layer, which prevents a downward percolation of water. When the water in its downward movement encounters the clay it begins a lateral movement (along the clay) under the trees, from which it is raised into the root zone by capillary attraction. Such an action is not possible in the Norfolk soils, and only to a limited extent in the Coquina phase of the Gainesville soil. I have made studies of the moisture content in the flatwoods and prairie soil formations but have never found such extreme variation of moisture as is found in the types so far considered. Usually the moisture content increased with the depth.

In the two soil types so far considered the principal cause of concern has been the dry soil. The continued curling of the leaves, and decline of trees into the rainy season can be attributed to continued dry subsoil regardless of the amount, intensity and distribution of the rain, and the moist appearance of the top soil. In several instances tender dry dead roots, half an inch or more in diameter have been found at depths from 6 to 10 inches encased in a dry cylinder of soil about 8 inches in diameter. In one instance there was only 1.64 per cent of moisture in the dry cylinder whereas the soil surrounding the cylinder contained from 6 to 7 per cent of moisture. Saturation is almost impossible in the Norfolk soils, but in the Gainesville soils a tree may suffer from either too much or too little moisture.

The story of the tree injured by water is well known to the grower. He knows the low places in his grove, and what to expect from the heavier types of soil, yet

after a dry season sets in he is prone to forget that the soil was once saturated, and how wet a certain area was during the last rainy season. Then he begins to wonder what ails certain trees planted in the Portsmouth and St. Johns soils, as well as in the Parkwood. These soils are all low lying, contain considerable organic matter, and are not well drained. Because of this the root systems are usually shallow. However, after several succeeding years of light rainfall, or of evenly distributed precipitation, the ground water is lowered to an unusual depth and the tree sends out deeper roots. The inevitable wet year follows; the water table rises, submerges the roots and the development of the tree is again checked. The deep roots are killed and the top necessarily suffers. Possibly the water in the ground will lower and some of the deep roots survive. The dry period follows, the soil dries out from the top and the feeding roots are affected, and since both the top and deep roots may be affected there will not be enough roots remaining to satisfy the transpirational requirements of the tree. The condition of the tree at the time it is subjected to these extremes may have an influence on its subsequent behavior. One instance observed will support this statement.

It was noted in one grove that a tree put on an excellent flush of growth while an adjoining tree, subject to the same conditions, did not. Later, the soil surrounding both trees was saturated for several weeks. Today, the tree which had put on the flush of growth is alive, and is suffering but slightly from the effects of the water, whereas the other tree died about 3 weeks after the water disappeared from the surface. The one tree undoubtedly survived because of its initial healthiness.

Adequate drainage will be beneficial to citrus trees planted in soils of the St. Johns and Portsmouth types, or other sandy soils containing considerable organic matter in the top section which tends to retain the moisture. These soils are moistened uniformly, as a rule, because of their low-lying position, texture, and nearness to the underground water. Seepage plays an important part in the replenishment of water removed.

The low marl hammocks and clays of the Parkwood series—particularly the marl—present a more difficult problem from the moisture standpoint. These soils usually contain considerable organic matter in the top soil but are underlaid with clay, soft marl, hard marl, or limestone rock. The hard layers undulate, and under such configuration alternating wet and dry periods are injurious to mature trees. To illustrate: A tree about 14 years old, and having a spread of about 20 feet—was located where the hard marl layer varied from 9 inches to more than 5 feet deep. On the east side of the tree the soil dried out to the critical point when there was a saturated soil at the depth of 2 feet on the north side of the tree. In this instance the southeast quarter of the tree had a shallow subsoil, and the soil dried out even though there was an abundance of water in the northwest quarter. It might be added that the tree ultimately declined beginning first on the southeast side. Such a condition presents a rather difficult problem.

The root zone is limited due to the underlying hard marl. A removal of the excess water by drainage is necessary; and, because of the impossibility of moisture replenishment through the hard marl layer, and the restriction to downward root development by the marl, irrigation should be practiced. If irrigation is practiced the roots will secure the necessary moisture at shallow depths, and therefore they will not be so liable to injury during wet periods.

Where the softer marl subsoil prevails in the low hammocks, good judgment must be exercised in providing means for the removal of the excess water. Overdrainage has been accomplished in some instances, and "frenched" leaves have resulted. By removing the excess water the roots are permitted to come in contact with the excess carbonate of lime in the soil; or the soil solution may become too concentrated, and the roots injured thereby. This condition has been observed in several instances. In one, a ditch was cut through a ridge in order to drain a low area several acres in extent. The extreme cut was from 3.5 to 4 feet. Immediately following the completion of the ditch trees along it, and for several rows back, began to decline, with "frenching," or chlorosis as the principal symptom. In the same grove a box drain was laid to drain a low area and also to provide an outlet for water from a well. It was laid 3 feet deep. Again chlorosis appeared where none existed before. Investigation disclosed the fact that the soil was more dry over the drain than at a point 30 feet away—which was to be expected. However, in this case the removal of the ground water by the drain worked a disadvantage to the tree, in that during periods of deficient rainfall, the roots went deeper and came in contact with the excess calcium carbonate in the subsoil. Away from the ditch there was less need for the roots to extend downward and consequently they were less affected. Overdrainage was responsible for this condition, and care must be exercised in draining this type of soil to provide means to remove the surface water only.

Citrus trees have declined both slowly and rapidly in the low marl hammocks. Generally, the decline is slow and the trees have shown symptoms of water injury, but several cases have been observed where the tree has gone rapidly. In all such rapid cases there has been an underlying hard layer close to the surface,, which had a decided influence on the moisture conditions.

There are two important matters to be determined in dealing with the soil moisture problem (1) the extent of the capillary movement of the water in the soil, and (2) the lowest moisture content which will permit the tree or plant to maintain a healthy growth. From the first we can get an idea of the possibility of re-moistening the soil after it has become dry, and from the other we can determine the minimum reduction of moisture permissible in the various types of soil.

As a result of studies thus far made it appears that in the sandy soils of the St. Lucie and Leon series (or the scrub soils as you generally recognize them) the extreme movement of water by capillary action will not exceed 15 inches in the

finest sand and about 10 inches in that of coarses soils. In the yellow soils of the Norfolk series there is a greater range, but the maximum so far obtained does not exceed 18 inches. The maximum figures in each case have been obtained when the soil had been moistened before being placed in the capillary tube. When the soil was placed in the tube in an air-dried state an irregular rise resulted. In one soil now under observation, the moisture has raised 14¾ inches in the soil moistened to 1½ per cent, and only 5 inches in the column containing the air-dried soil—both samples from the same composite material. This would indicate that the initial moistness of the soil will influence the moistening of the soil after it has dried out to a certain extent. That the limited range of capillary movement appears in the field will be substantiated by the following record of moisture in Norfolk soil. The water descended the trunk of the tree and then followed a slight depression (about 1 inch deep) to the water furrow. The center set of samples was taken in the center of the water course; the others 18 inches to the right and left, and about two feet from the trunk of the tree.

TOTAL MOISTURE

Depth inches	Left per cent	Center per cent	Right per cent
6	2.1	7.6	6.7
12	6.6	8.0	2.7
18	2.1	7.8	2.1
24	2.4	8.6	2.1
30	2.9	6.5	2.3
36	3.9	—	3.5

It is known that the soil moisture content can be so reduced that there will be no capillary movement of water through the soil once that point is reached, and that if the moisture is further reduced the root will become permanently affected. The point where there will be no capillary movement has been designated as the "moisture equivalent" of the soil, (or capillary equilibrium) and the point where the root becomes permanently affected is called the "wilting coefficient."

These values vary with the character of soil but have the same effect on different plants and on the different ages of the same plant. It has been found that a plant will grow when there is only 2 per cent of moisture in coarse sand, yet the same plant will wilt in fine sandy loam containing 10 per cent of moisture. Even greater variations have been found. From this you can see the application to our Florida soils. Our organic soils will require more moisture to keep a plant from wilting permanently than is needed in the lighter soils; and a higher moisture content must be maintained in sandy loam to clay loam soils of the prairies than in the more sandy soils in order to secure the maximum growth. The "moisture equivalent" coefficient of any soil may be regarded as the critical point in its moisture relation, since below it there is no capillary movement of water to replenish the soil, and unless the water is forced in by gravity any root within the area for a sufficient length of time will become affected. That you may further appreciate the importance and significance of the moisture equivalent of a soil it may be stated that if two different

soils having different values are moistened just to the moisture equivalent percentage and placed in contact there will be no movement of moisture from one to the other even though the actual moisture content of one soil is 10 per cent greater than that of the other.

In view, therefore, of the moisture equivalent values and the limited capillary action in the different soils, the irregular moisture conditions, and the difficulty in moistening a dry soil in the area under consideration it is not surprising that there should be such a large mortality of trees. Extreme dryness will cause root injury, and if protracted will result in a complete "kill." Extreme wetness followed by extreme dryness affects the entire root system—top feeders and deep roots. Likewise extreme variations in the soil moisture content at different depths, and at different locations under the tree will influence the development of certain portions of the tree which depend on the roots in that area for sustenance, so that with all these factors considered it is not unreasonable to suppose that there would be a physiological disturbance in the tree following the variations here presented.

(Note—In analyzing the following records it must be considered that the result shown is an average of the moisture in the 6 or 12-inch soil column, and that one part of the column may be either more dry or more moist than the figure given. For example: Take the 36-inch depth at 5 feet west—2.06 per cent in the section, but notes state dry, then moist; consequently there must have been a section in the column containing less than 2.06 per cent, therefore the moisture content was near the critical point and would affect any root in it.)

Soil Moisture Conditions Found Under 20-Year-Old Seedling Tree in Norfolk Soil. Tree shedding and twigs dying. Slight curl in leaves. June 23, 1924.

Depth	Percentage of moisture	
5 feet north		
6″	4.08	
12″	2.33	⅜″ live; dead feeders.
24″	1.97	⅜″ live at 15″, also affected, and live feeders.
36″	1.69	
48″	1.78	--
57″	3.21	
8.5 feet north		
6″	7.26	
12″	4.14	
24″	1.92	
36″	1.79	
48″	2.25	Dry top, moist bottom.
57″	3.57	
7.5 feet northeast		
6″	5.25	
12″	5.01	
24″	3.62	Dead, also live feeders.
36″	4.70	
48″	4.87	Dead, also live feeders.
57″	5.07	Live, and affected feeders.

Depth	Percentage of moisture	
5 feet east.		
6″	2.38	
12″	2.17	Dry. Dead ¼″ root.
24″	1.84	Dry. Live 3-16″, dead 1-16″.
36″	1.70	Dead feeders.
48″	1.79	Dry, moist, then dry.
57″	1.86	
10 feet east		
6″	8.47	
12″	3.51	Core to 11″ then dry.
24″	2.92	Dry. Citrus root shell ¼″ dia. Dead feeders.
48″	1.83	Dry top, core bottom.
57″	1.60	More dry.
7.5 feet southeast.		
6″	2.74	
12″	2.14	Dry. Dead feeders.
24″	21.9	Dry. Dead, and live feeders.
36″	1.68	Dry. Affected feeders.
48″	1.58	Dry top, more moist bottom.
57″	2.35	Old, dead feeders.

Depth	Percentage of moisture	
5 feet south		
6″	4.28	
12″	2.70	
24″	2.78	⅜″ live root at 20″.
36″	1.59	Dry. Affected feeders.
48″	1.60	Dry. Dead feeders.
57″	1.63	
8.5 feet south		
6″	2.92	
12″	2.21	
24″	3.12	Dry top, core bottom, dead roots and also live roots in core.
36″	4.92	
48″	2.63	Core, then dry.
57″	1.92	Affected roots.
7.5 feet southwest		
6″	1.78	
12″	2.24	Dead feeders, light in color.
24″	2.03	Dead feeders.
36″	1.99.	
48″	1.97.	
57″	3.01	

Depth	Percentage of moisture	
5 feet west		
6″	3.55	
12″	2.37	
24″	1.99	Dry. Dead feeders.
36″	2.06.	Dry, then moist.
48″	2.09	
57″	2.90	Moist; no roots.
10 feet west		
6″	2.81	
12″	2.62	
24″	2.35	Dry. Affected feeders.
36″	1.78.	Abundance of dead feeders.
48″	1.77	
57″	1.77	
7.5 feet northwest		
6″	2.64	
12″	2.25	
24″	1.92	Dead and live feeders.
36″	1.95	Dry top, moist bottom.
48″	4.61	
57″	5.31	

Note—The percentages of moisture shown are averages of 6 or 12″ columns of soil.

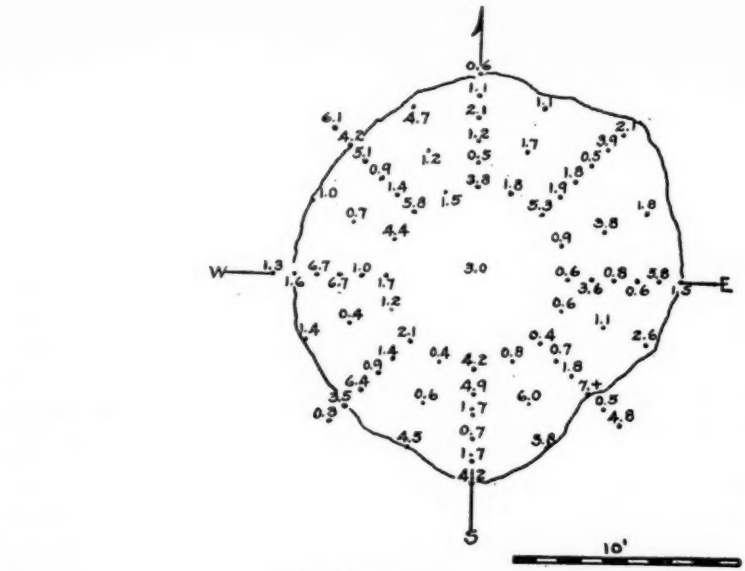
Results and field notes for large orange tree about 12 years old in Gainesville sandy loam. Leaves becoming lighter in color. Northeast side frenching. Southeast side curling most, although curl all over. No growth. Top dry July 1, 1924. Rainfall: May 3 inches, June 4.51 inches.

Depth	Percentage of moisture
5 feet north	
6″	3.04
12″	4.56
24″	2.95
36″	2.11
48″	2.05
57″	3.88
9 feet north	
6″	1.98
12″	1.41
24″	1.59
36″	2.20
48″	1.35
57″	1.64
7.5 feet northeast	
6″	2.69
12″	2.66
24″	3.15
36″	3.95
48″	6.36
57″	11.55

Depth	Percentage of moisture
5 feet east	
6″	2.13
12″	2.53
24″	2.78
36″	3.37
48″	1.48
57″	2.80
9 feet east	
6″	1.88
12″	2.67
24″	3.07
36″	3.66
48″	2.38
57″	2.18
7.5 feet southeast	
6″	2.33
12″	1.69
24″	2.00
36″	3.69
48″	---
57″	3.98

Depth	Percentage of moisture	
4.5 feet south		
6″	2.24	Dry. Dead ⅛″ root.
		Dry. Dead ⅛″ root.
12″	2.87	
24″	3.27	
36″	3.55	
48″	2.41	
57″	6.93	
9 feet south		
6″	4.53	
12″	1.68	
24″	2.08	
36″	3.34	
48″	2.89	
57″	6.19	
7.5 feet southwest		
6″	2.41	
12″	2.17	
24″	2.96	
36″	3.28	
48″	2.89	
57″	3.13	

Depth	Percentage of moisture	
5 feet west		
6″	4.41	
12″	3.24	
24″	3.48	
36″	3.22	
48″	3.14	
57″	3.91	
9 feet west		
6″	2.96	
12″	2.76	
24″	2.69	
36″	3.58	
43″	5.18	Rock.
7.5 feet northwest		
6″	2.51	
12″	1.74	
24″	2.75	
36″	3.72	
48″	2.44	Bottom dry. Slight red sand clay.
57″	3.87	Clay.



Tree spread, and depths to rock

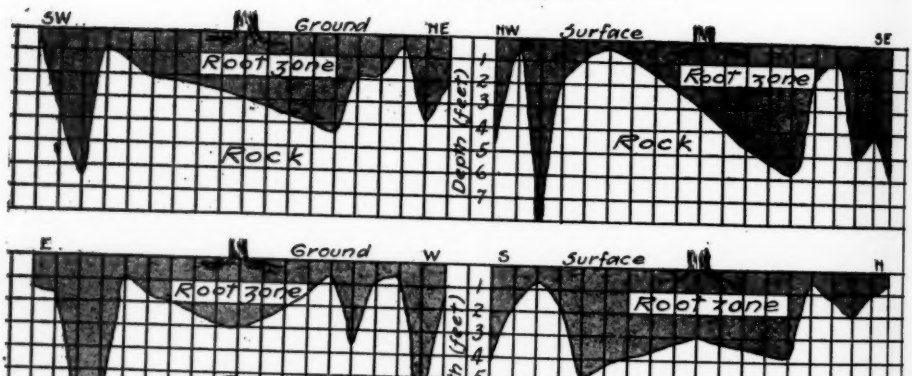


FIG. 1

Economy in Citrus Fruit Production

E. F. DeBusk, College of Agriculture, Gainesville.

The economic problems of the Florida citrus fruit grower are grouped around marketing or distribution, cost of production, and the production of fruit of better quality. In discussing the approved, as well as wasteful, practices that enter into the cost of production and quality, we must not lose sight of the important relation between these factors and the problems of marketing.

Being a practical citrus fruit grower, I shall not attempt to outline and recommend definite methods of fertilizing, cultivation, or pest control, for the citrus belt or for any part of the citrus belt. I can only hazard a few general suggestions. A plan of grove management must be worked out for each individual grove, after a thorough study of conditions. Any plan of grove management must be flexible enough to take care of every conceivable emergency from a seven-cent-per box market to a six months combat with a new aphis, and still give the grower a profit on his grove operations. Let me stress that point—"profit on the grove operation." I fail to see how any practical citrus fruit grower can afford not to be governed by the probable profits on the grove operation in incurring the expense of same. Of course this does not apply to the grower who is in the business of growing citrus fruits simply for his health and for pleasure.

Fertilizer is our chief item of cost in citrus fruit production, a very important factor in the production of fruit of quality. At the same time, less is known about proper citrus fertilizing than any other factor of production. It seems that the more we learn about fertilizing a grove, the less we know. About the only safe guide is to study the needs of the tree under the conditions, and fertilize accordingly. After twenty-five years of scientific citrus fruit growing in Florida we find some of our leading growers varying their fertilizer applications from five to fifteen pounds per box under similar soil conditions, and you can scarcely find two fertilizer experts who agree on fertilizer recommendations for a specific grove. One grower uses two per cent ammonia and produces "ammoniated" fruit, while another under similar conditions may use four per cent ammonia and produce fruit with no "ammoniated." However, as a whole, we have been wasteful in our methods of fertilizing citrus groves, under the usual cultural practices. It might seem unwarranted under the present trend of things to say that many of our growers have been extravagant in the use of fertilizer, especially nitrogen. We have made the serious mistake of trying to build soil fertility by the use of heavy applications of commercial fertilizer alone. Young

trees have too often been forced to bearing size, and bearing trees fertilized for maximum box production, with undue attention given to the health of the tree, building up the fertility of the soil, and producing fruit of quality. In fact, the biggest trouble with the Florida citrus industry, as I see it, is quantity production. The industry has been built upon quantity production, at the sacrifice of quality.

The quality of our fruit can be greatly improved by building up the fertility of the soil through the use of cover crops and manures. As the fertility of the soil is built up, cultivation and the amount of fertilizer may be reduced and the quality of the fruit greatly improved, thus reducing the cost of production and bringing more profits to the grower. Re-seeding cover crops should be used when practicable.

Much fertilizer, especially the nitrogen content, is often wasted by making heavy applications on light soils, more or less void of humus. On such soils the total quantity for the year should be divided into at least four applications for bearing trees, and five or six applications for non-bearing trees. At the same time a special effort should be made to encourage the growth of cover crops and build up the soil fertility. The fertility of the soil must be built up by the use of cover crops while the trees are young or before the trees are planted, and by leaving the cover crop on the ground. As the trees grow larger, shading the ground, less cover crop can be grown, and more manures must be applied. It must always be borne in mind that it is only through the use of cover crops and manures, supplying the necessary humus and soil bacteria, that the maximum results from the use of commercial fertilizer, in both quantity and quality of fruit, can be obtained. We must give more attention to quality in both fruit and trees, in our methods of fertilizing and cultivating citrus groves. Consumers of our fruit are demanding better quality than we are producing—better quality of fruit and a real standard of pack—and this demand is on the increase.

At the present stage in our citrus industry the production of quality, as far as practicable and economical, should be the dominating purpose in fertilizing and cultivating our citrus groves, as well as in pest control. As a general practice we are plowing groves too much for the best quality of fruit as well as for the general health of the trees. In many groves, irrigation and the mowing machine should be substituted for most of the plowing and cultivation. While we have no experimental data on the results of plowing bearing groves in Florida, a survey of grove practices in California has brought out the fact that there is no difference in average yield between the plowed and unplowed groves for a period of five years. It seems that there would be less reason for plowing our sandy Florida soils, as a rule. The benefits of a light cover crop are often lost by turning it under too deeply, thus losing its stimulating effects on succeeding cover crops.

Money is often poorly invested in hoeing the grass away from large bearing trees, simply because it improves the ap-

pearance of the grove. Of course the grass should be hoed away from young trees, and there are exceptional conditions under which it is advisable to take the dry grass away from large trees in the fall as a precaution against fire.

In view of the fact that approximately 19 per cent of our 1923-24 crop of oranges graded brights, 43 per cent golden, and 38 per cent russets, and that there is an increasing demand for bright fruit in the markets, it seems that many of our growers can well afford to invest more money in disease and insect control for the production of bright fruit. Especially is this true when the market is willing to pay around one dollar per box more for brights than for russets and when the grower can make from 100 to 500 per cent profit on his investment in the control of the common factors that produce russet fruit.

Melanose is our principal factor in producing russet fruit; the rust mite comes second. Many growers want to know how much melanose they can afford to have before the expense of spraying for its control is economically justified. I can only answer the question by saying that, in groves where 30 per cent of the oranges were melanose russets, we have been able to reduce the melanose russets to 5 per cent by spraying with Bordeaux-oil, at a total cost of 6¼ cents per box, producing a profit of around 300 per cent on the spraying investment. But the greatest profits from grove operations during the last few years have come from one or two sulphur dustings, at the proper time and done thoroughly, for rust mite control. And right here is the place for a large percentage of our growers to invest under the present conditions. But, for the sake of economy, stop spraying in the bloom for rust mite control. You can never prevent the coming of rust mites. Wait until they are present in dangerous numbers, and then dust or spray with sulphur, to kill. In order to be effective and economical, grove pest control measures must be applied at the proper time and thoroughly. This calls for a careful study of grove pest problems and timely preparations for best results. Too many growers do the spraying "when they can get to it"—at the most convenient time. That probably accounts for the fact that 50 per cent of the spraying done in the Florida citrus groves is less than 65 per cent efficient. Just recently the writer made some observations in a grove that was dusted with nicotine-lime dust for citrus aphis control while the wind was blowing and found that less than 40 per cent of the aphis had been killed; while in another grove, where the dusting had been done when it was calm, the kill ran around 99 per cent. The former was not profitable; the latter was.

We hear a great deal about reducing the cost of production of citrus fruits. Some growers say it cannot be done; others say we can, in most cases, reduce the cost very materially. When the cost of producing oranges commercially is ranging from 15 cents to $1.50 per box, it seems that there are opportunities for improvement in the cultural practices of a few of our groves, at least. There can't be such a wide difference in the soils and other natural conditions throughout the

citrus belt. We find the cost of fertilizer ranging from 10 cents to 20 cents per box under very similar conditions. The cost of spraying will vary even more.

The first step in reducing the cost of production is to analyze the cost. Then study each element of cost as a factor in production, on the box basis. Growers should keep a complete record of all grove operations, including cost. In this way you will soon locate the faulty practices and unprofitable grove operations or expenditures, if you are a business man, and immediately begin to see where changes can be made in your grove management that will either reduce your per-box cost of production or result in the production of fruit of better quality and more profits. It's the net profits that we are after. Increasing the production cost, or the total cost of operating a grove, may often result in more profits through the production of better fruit. Keep ever in mind the probable profits in each and every grove operation. Do not spray simply because your neighbor is spraying, or because you see a few insect pests sticking around. It is one thing to kill insect pests or control a citrus disease, and another thing to make a profit on the cost of the spraying operation. It is the "high dollar" that we are working for in every grove operation. Five cents per box saved in the production cost is equivalent to receiving five cents more per box for the fruit in the market. An unnecessary or unprofitable expenditure in maintaining a bearing grove or in producing a young grove is an investment that will never produce a profit or draw any interest.

The successful grower must know his grove tree by tree. More attention should be given to individual tree records. It is surprising to know the percentage of drone or unprofitable trees in some of our groves. In some cases we find that 20 per cent of the trees are carrying the whole grove. In some groves, more than half of the trees are decidedly unprofitable. The citrus industry should not be required to carry a lot of boarder trees or any other avoidable expense. An individual bearing orange tree represents as much of an investment as the average dairy cow did when the dairy industry launched the campaign for weeding out the boarder cows. Top work or cut out unprofitable trees.

And then, after spending 50 weeks of the year and a lot of good money producing a crop of fruit, many of our growers thoughtlessly turn the crop over to a careless picking-crew who may, within the remaining two weeks, destroy all of the profits of the year through their rough handling of the fruit from the tree to the packing house.

The cost of marketing our fruit must be reduced, so that the price to the consumer will be within his reach.

After all, it is only the grower who is willing to give personal attention to details in fruit growing, study his problems and apply the principles of sound economy,, that will finally succeed in the production of citrus fruits. As the Romans used to say, "The tracks of the owner in the field is the best kind of fertilizer that can be used." They must have had reference to the citrus grove.

Economies in the Growing of Citrus Fruits

J. G. Atherton, Howey.

I believe that the production of citrus fruits is on a strictly competitive basis and the grower that can produce a quantity of quality fruit at reduced cost is going to be the successful grower.

My discussion, as a member of the Committee on Economics in the Growing of Citrus Fruits, is confined to cultivation which is generally understood to include plowing, harrowing, hoeing, applying fertilizer, picking roots and banking trees, together with sowing cover-crops and the mowing thereof.

Systematically handled and properly organized, this general cultivation should cost not over $10.00 per acre per annum.

The operations as I will outline them have been thoroughly tried and tested on the Howey tract at Howey-in-the-Hills Lake County, Florida, where over five thousand acres are under cultivation and the methods employed have been adopted after experimenting in a good many ways and were finally chosen as the most practical and economical for our hill section.

We establish blocks of 600 acres on which we erect living quarters together with mule and equipment sheds. The living quarters should have at least four rooms. The mule shed should be large enough to accommodate six mules and to store grain and hay. The equipment shed should be large enough to shelter the following equipment:

3 two-horse Acme Harrows
3 two-horse Plows
3 Disks
3 four-foot Acme Harrows
2 Mowing Machines
1 Wagon

And sundry small tools,
all of which represent an investment of approximately $3790.00. A spring tooth harrow and a one horse plow would have to be added to this equipment if local conditions required it.

Man power for this block consists of three salaried men, and extra day hands are used for planting cover-crops, fertilizing, hoeing, picking roots and banking trees, but are used on these operations only when and as needed. When such work is completed they are transferred to other operations.

It is sometimes practical to organize day crews for these miscellaneous operations and send them from block to block under one foreman to the crew.

Beginning with the first of the year and assuming that all plowing has been completed for the preceding fall, each salaried man with his team pulverizes the ground to whatever extent necessary using either the disk or harrow or both, and covers 200 acres. This operation is then repeated on an average of every 10 to 15 days during spring cultivation, al-

though this period may be shortened or lengthened, depending upon rainfall.

When the summer rains start, he zigzags and straight furrows next to the trees with a 4-foot harrow, alternating and repeating the operation every 10 to 15 days, shortening or lengthening the period to obtain the best moisture and vegetation control and continues with this for the balance of the summer, or until ready for fall breaking.

Before fall breaking however, he must also mow the cover-crop once or twice and store any hay which has been made on his tract.

He then starts the fall breaking or plowing, and plows 20 to 30 acres or a sufficient acreage so that he can harrow for at least one day. This operation continues until his entire 200 acres is completely plowed and harrowed.

In this way, the salaried men and their teams are kept busy the entire year. All of this however, deals with non-bearing groves.

If the 600 acre block is all in bearing the work would be laid out as follows:

After the non-cultivation period or after the fruit crop is removed, intense cultivation is started, using the Disk or Acme harrow or both, and repeating the operation every 10 to 15 days until summer or the rainy season.

The salaried man and team can then be used for spraying, making hay or any other work of this kind and with an occasional hoeing this practically completes the necessary cultivation in a bearing grove.

There is therefore, quite a difference in the care of bearing groves and the care of young groves, as the team would be idle during the non-cultivation period except when used on mowing, spraying or other miscellaneous work but during these idle periods the team can be pastured, thus reducing feed bills, or it may be possible to rent it or use it for other operations which you might have on your tract.

The salaried man on the contrary will find plenty of work to keep him busy in the bearing groves and can assist in pruning, spot-working and so forth.

I believe however, the secret in reducing cultivation costs lies in establishing a unit which a man with his team can and must cover during a certain period of time.

Some of the things to be watched closely are as follows: Operations should never be changed during the middle of the day. Mules should not be overworked although capacity work should be obtained from them. Care of mules and equipment must be the very best.

In some localities tractor work is practical, but in a hill section such as ours we have found it to advantage to use mules both for efficiency and economy.

The cost of $10.00 per acre per annum, which I first quoted, was taken from cost records on three blocks or 1800 acres and in which there were 147 acres of bearing grove. It includes all cultivation labor, repairs, maintenance, upkeep and depreciation but does not include supervision.

Supervision includes the salary of the Horticulturist or Superintendent, and his inspectors, also maintenance and upkeep

and depreciation on the cars which they use.

Cost of Supervision would therefore, vary in accordance with the size of the tract and would be determined entirely by local conditions and service given.

In conclusion I trust that this will be of some benefit to growers and the Society and I will be pleased to have any of you make an inspection of the effectiveness of these methods which is best evidenced by the condition and appearance of our groves.

Economies in the Growing of Citrus Fruits

A. C. Nichols, Bartow.

Spraying, as all of our grove work, should be done as economically as possible, particularly when the following of an adequate minimum spray schedule will run to quite a percentage of the cost of the care of the grove. As we wish to save, we might first consider the mechanical features of the job. There is really nothing new here but it might be well to review them a bit.

First might be mentioned preparedness. It is good business to go over a machine as promptly as possible after use and be sure it is in A-1 shape. Parts may be obtained and installed at leisure. Then it is off one's mind and if sudden occasion arises for its use, the machine will cause no delay; and repairs and adjustments that, when made in the field, are unduly expensive, will be minimized. Likewise parts that need frequent replacement should be on hand ready for use.

Second we should have some excess spraying capacity. I mean by that sufficient equipment which will cover the grove in the required time with some leeway for delays, which frequently occur in spite of preparedness as well as from unsuitable weather. The outfits should be amply powered so that any slight loss of power of the engine does not handicap the work by reduced pressure or tinkering delays. In am coming to favor large capacity machines where the acreage and size of trees justifies. The two nozzle gun makes for considerable increased speed though I think it is somewhat wasteful of material. However, in most of our spraying the cost of application is greater than that of the material used (with the exception of Bordeaux-Oil) and I figure the increased speed means a net saving. For instance, we have recently installed a large machine, with a rated capacity of 20 gal. a minute and a 300 gal. tank. Our experience with this machine using two nozzle guns is that we are getting out 11to12 300 gal. tanks a day against 9 to 10 200 gal. tanks of smaller machines with single guns. As against this increase in volume of spray of about 75 per cent our actual coverage in a day is increased 50 per cent, and possibly more, and with at least equal efficiency.

Third we have the human element in getting the right men for applying the spray. Ideal spray hands are certainly few and far between, men who are not only careful to get the complete coverage desired but at the same time get it without wasting material and slowing up the job. However, if the man has the natural activity together with the willingness to learn, profit by mistakes and try his best to do what is shown, he will go a long

way after practice, trial and frequent examination of trees just sprayed to see wherein he might have failed to cover. The usual routine of starting on the far side of the tree, and working around inside and out is more easily learned.

Now another matter of economy is to reduce the waste time of the spray outfit in going for water. At times this can be done by hauling water to the outfit which can frequently be satisfactorily handled, on 200 gal. outfits with another team and one man. However, spraying quite generally comes when there are other needs for mules and it is sometimes difficult to work this out. Another way to cut down long hauls is to carry the water through the grove in underground pipes with occasional standpipes through the grove. In a case I know of where this has been done the increase in the amount of spray gotten out, averaged over the whole grove, has been about 10 per cent. I figure the saving from lost time due to this installation to be between 15 and 20 per cent on the investment.

There is of course the added feature of more prompt completion of the job—an end always to be sought.

Having considered the mechanical side of the applications, can we save on the materials used? Where one cares to make their own emulsions and sulphur sprays the answer must be yes, as a little figuring on published formulas will show. For instance, on one property I am acquainted with they have been making their own oil emulsion for over a year at a total cost per gallon of not over half the cost of ready mixed materials. This is the boiled and pumped emulsion. The equipment used is nothing but a 60-gal. syrup kettle and an old spray pump. The formula they use carries a bit more soap than the Government formula, uses flour and glue as a stabilizer and needs no preservative as it is mixed as needed. The emulsion mixes perfectly in deep well sulphur water and the results obtained by its use are excellent. The new emulsion obtained by the use of Kayso and pumping is even cheaper than the so-called Government formula. From observation of its use I think it would be satisfactory for use in the Fall as the kill is excellent, but I would hesitate to use it when cold snaps were liable to occur, for when used at the same strength (1 per cent oil) as the regular emulsion it has seemed to me cold caused excessive leaf droppage coming within 10 days after its use. I have not observed it in Spring or Summer use, but I would try it very cautiously, watching carefully for possible burns on the tender young fruit.

In the case of home mixing of lime sulphur, there is a saving to be made here too, in cost. It is not as great, however, as in the oil emulsions and there is generally a considerable variation in the strength of the completed product. Unless one is able to test and watch the use of each barrel, with proper variation to give the resultant strength of diluted spray desired, its use by ordinary spray hands cannot be recommended.

Our experience has shown there is an economy in dusting instead of spraying for rust mites, after we initially clean up our trees after the bloom with sulphur

spray not only to get free from rust mite until June or July, but also to get the jump on and eliminate as much as possible danger from red spiders and six spotted mites.

The aphis has caused a large expense for dust and sprays. I might suggest that there is a saving to be effected in case of the nicotine dust in mixing your own where much of it is to be used. A barrel made to turn on an axis by a crank, with a door, screen and stones or other small hard weights inside is all the equipment needed. Tables and directions are furnished by the makers of the nicotine product.

Briefly, then, assuming a certain amount of spraying to be done, the least cost will be obtained when we have the proper equipment, properly manned and operated, with the least lost motion, and materials obtained on the best basis consistent with results obtained.

Plant Propagation

W. L. Floyd, College of Agriculture, Gainesville.

Fruit growers today generally plant budded or grafted trees. Many of them give but little thought to the stock used. The using of stock from seed of varying habits of growth and taken from trees of different types are important factors in the development of plants of uneven size and fruitfulness. For best results seed for nursery stock should be taken from good trees of the kind desired. When the seedlings have reached the age for transplanting from seed bed all inferior ones should be thrown out. In the nursery rows all small poorly developed plants should be discarded before grafting, and only the vigorous grafted trees should be transplanted to the orchard. By starting with as good seed as possible, culling in seed bed, nursery row and at time of final transplanting, more uniformly vigorous trees will be obtained.

A grafting wax that may be heated and applied with a brush in same manner as paraffin in the Morris method is made of:

5 parts resin
1 part beeswax
1-4 part linseed oil by weight
1-4 part lampblack or powdered charcoal.

This sticks better and does not crack so readily as paraffin.

Instead of the Morris heater a simple and quite satisfactory one may be made as follows:

Perforate a ten quart galvanized bucket on the bottom and sides with a number of 1-4 inch holes and next a pan in the top. On the bottom of the bucket put two small cans of "canned heat" and light. Place the wax in the pan above where it will be kept melted and ready for use.

The use of the solar propagating frame for rooting difficult cuttings of subtropical plants is increasing and proving very helpful. A description of this is given in U. S. D. A. Department Circular 310. There appeared recently on one of our horticultural journals the following:

"In the Botanical gardens of Edinburg it was found that cuttings root more surely in an acid medium. Experimental plots were treated with water in which peat had been soaked for some time. Later acetic acid in the form of white vinegar was mixed with water 3 teaspoonfuls to one gallon, and used to water the cuttings, which rooted more quickly and completely."

I have not tried this out but give it as a matter of interest. Think it may prove valuable especially for plants which are tolerant to or thrive in acid soil.

The activity in building in Florida is stimulating increased interest in ornamental plants suitable for home plantings. Many of these introduced from other re-

gions when propagated on their own roots do not grow well on sandy and sandy loam soils, so abundant in Florida, some others are attack by the root knot nematode. We have learned to adapt citrus trees to different types of soil by budding on different stocks, and similar practice is giving greater success with other plants. For example roses on Cherokee or Texas Wax stocks are giving better results than hitherto attained.

The beautiful evergreen shrub wax privet (Ligustrum lucidum) so well suited for border and foundation plantings is attack by nematodes, by grafting on L. ovalifolium or Quihoui we develop plants resistant to the pest.

Certain dioecious plants as holly may all be grown of the more desirable pistillate form by grafting cions from pistillate parents upon seedling stock.

Whether there is anything gained by grafting grapes such as Carman and Munson, instead of growing them from cuttings is still doubtful; it seems probable that a stock may be found that will give better results on soils now considered unsuited to grapes.

There is a fertile field for research in seeking out congenial stocks for plants now considered unsuited to Florida conditions or which grow in a weak and unsatisfactory manner. Instead of saying they can't be grown let us with patience and persistance find a way to grow them.

The Grafting of Plants

J. W. Barney, Bradenton.

The past few years have shown a constantly increasing interest in certain phases of citrus grove management looking to economy of production. Prominent among these economies is the getting rid of the "boarder" or "drone" trees by replacing them with new trees, or, better still, grafting them with scions of proven fruitfulness.

The "proximal slot graft," which has proved so satisfactory with the writer, and which has been the subject of much discussion at recent meetings of the State Horticultural Society, and, generally in horticultural papers, is gradually being recognized as being a logical and practical method of making these much needed changes in our groves. But, up to this time the need for such changes has been confined to work on the occasional trees in the grove that were not doing their full duty in the way of fruit production. The situation now, however, particularly in the case of grapefruit, suggests changes in the character of entire groves—thousands of trees. To destroy these already well established trees to make room for new plantings entails an outlay and loss that should be well considered before being undertaken.

The writer has strongly advocated the "proximal slot graft" method for rehabilitating the occasional trees, even if they are in considerable numbers, but in working over such trees there is always the expense of gradual trimming and the subsequent removal of the brush to be considered as a part of the expense of the changes made. As against this expense, and as a set-off is urged the great saving in preserving, by reason of the gradual change made in the tree, of a large part of the old root system which is lost if the tree is destroyed or cut off for building in the resulting saplings. But, when we are to consider the changing of an entire grove, or large blocks of trees, as is in many cases now proposed, we feel certain that this loss of roots would be compensated for by the saving made by doing away with the trimming at once by cutting off the tree top and slot grafting the stump, allowing the unrestricted growth of saplings, which can be disposed of as the grafts grow, or, used for budding in case the grafts fail.

The process is about as follows:

Cut off the old trees, if possible about two feet to three feet from the ground and insert the slot grafts, as many as you think best, around the upper rim of the stump using the melted paraffin to cover all cuts, as directed in former papers upon this subject, and paint the top of the old stump with thick paint, or pine tar, or grafting wax, or paraffin—anything that will protect it against drying out or the inroads of disease.

This method is called the "Distal Bark Slot Graft."

It is suggested that the grafts be set fairly well down from the exact upper rim of the stump so that they will not be affected by any drying out of the upper edge of the old bark. The grafts should be cut precisely the same as for work upon other parts of the tree, and inserted under a lip of bark extending from the rim of the stump downwards, and should be nailed on with small brads and supported in other ways, if thought necessary. It is quite likely that shade over the grafts at first will be helpful, and they should, when needed, be supported by stakes nailed to the tree.

The writer takes the liberty of suggesting that the results of work of this kind is largely dependent upon the care with which it is done. It is a surgical operation in which cleanliness of hands and tools are indicated. It is also stated that paraffin is not used merely for a stopgap. Its chief function depends upon it being translucent. Light rays easily penetrate it and are of importance in promoting a prompt healing of the wounds and a knitting of the parts. Conditions are not so favorable when opaque or cloudy waxes are used. The mixture of about 2 per cent of "Carnauba" wax with the commercial paraffin will raise the melting point just about right for Summer use and prevent the wax running on our hottest days.

Fake Fertilizers

R. E. Rose, State Chemist, Tallahassee, Florida.

Ladies and Gentlemen: Fellow members of the largest and oldest Horticultural and Agricultural Association in Florida; and probably the largest consumers of commercial fertilizer in the State:

Florida consumes from 350,000 to 400,000 tons of high grade commercial fertilizer annually, with an average commercial value of approximately $32.50 per ton. A total of eleven to thirteen million dollars per annum expended for fertilizers.

We have recently had some correspondence with an attorney representing a firm offering to sell ground Feldspar at $38.00 per ton; more than $5.00 per ton in excess of the average state value for the high grade commercial fertilizers sold in Florida during 1924. This material was largely sold in 1913, until stopped by the Chemical Division, as shown by the State Chemist's report for 1913, pages 11 to 15.

We have received a circular by mail "Pulverized Lava Rock (Stone Meal);" also designated as "McCrillis Stone Meal," "Nature's Complete Soil Restorer and Crop Producer," offered for $38.00 per ton in carload lots, strictly cash.

This material is described as "The Best and only true natural plant food is: *Stone Meal* (finely pulverized meteoric rock) as it holds in *natural polarically unified combination* all that is necessary to produce a *unified mineral soil* which will bring forth sound, wholesome crops and acts as a disinfectant and insecticide."

This is but an echo of "Bread From Stones," the "New Mineral Fertilizer," and others of similar character, as have been exposed from Maine to Florida; particularly in Florida in 1913.

Probably no pamphlet has been published that contains more mis-information, calculated to deceive the farmer, than this pamphlet which has been widely scattered throughout the country, particularly in the Eastern and Southern States.

An analysis of a sample of McCrillis' Stone Meal, taken from a lot of 19 tons seized at Tampa, shows:

Ammonia	0.14%
Available Phosphoric Acid	0.22%
Insoluble Phosphoric Acid	0.93%
Potash (K_2O)	0.35%

The commercial value of this material, from the foregoing analysis is $1.40 per ton at present state values; or $36.60 per ton less than the price ($38.00) at which it is offered for sale.

The Norfolk and Portsmouth sandy soils of the State have the following average analysis:

Ammonia	0.04%	at $4.60 per unit	=0.18
Total Phos. Acid	0.16%	at 0.37 per unit	=0.06
Potash	0.009%	at 1.25 per unit	=0.02
A total state fertilizing value of, per ton			0.26

while McCrillis' Stone Meal has a state value as follows:

Ammonia	0.14%	at $4.60	=0.54
Total Phosphoric Acid	1.14%	at 0.07	=0.43
Potash	0.35%	at 1.25	=0.43
A total value of, per ton			1.40

I would also call your attention to the analysis of Florida muck soils, which show an average of

Ammonia	3.10%	at $4.60	=$14.26
Total Phosphoric Acid	0.18%	at 0.37	= 0.07
Potash (K_2O)	0.08%	at 1.25	= 0.10
A total state value of			$14.43

per ton, or $13.03 in excess of the state value of McGrillis' Stone Meal.

In this connection, I quote from my report of 1913:

"There are millions of acres of soil in Florida that contain (on a dry basis) two or three per cent of nitrogen, which can be readily made available. There are other large areas of soil with from one-half to three per cent of phosphates, and enormous deposits of low grade phosphate of lime and alumina, with one or more per cent available, and seven or more per cent insoluble phosphates (the waste of phosphate plants, in excellent mechanical condition that can be had for hauling); while there are other vast deposits of "soft Phosphates," with 1.50 per cent or more available, and 15 to 25 per cent insoluble phosphate, that can be had for digging and hauling. With such materials, abundant nitrogen and immense quantities of phosphates well distributed—having large actual plant foods readily made available—it is needless to say that it is folly to purchase absolutely inert material of less fertilizing value than good average Florida soil; which can be purchased by the acre at from twenty-five to fifty dollars per acre; of which six inches off the surface will afford 1,000 tons of material superior to this "New Mineral Fertilizer" in fertilizing value."

The wide-spread sale of this McCrillis' Stone Meal and similar materials is indicated by the following editorial from the American Fertilizer, of November 15, 1924:

"Another Fake Fertilizer."

"We publish in this issue a report of a fraudulent ferilizer which has been sold in Pennsylvania. The makers guaranteed only two per cent of plant food, but their product contained less than one per cent, having a value of about $1.75 per ton. The selling price was $28.00 a ton, and the records show that 300 tons were sold last year. The manufacturer was prosecuted and fined, but this brings no relief to the purchasers of fake material.

"Several of these worthless or near-worthless mixtures appear every year in different parts of the country. They are seldom heard from a second year, but in the aggregate they rob the farmers of a considerable sum. Their sale is usually in a restricted territory, although there have been a few widely advertised fakes. The department stores are a favorite medium of distribution for small packages, which are sold for use on lawns and gardens.

"No state fertilizer control can prevent these frauds without assistance. The legitimate fertilizer industry should be on the lookout for these fly-by-night concerns. Samples of their stuff should be secured promptly and sent to the State chemist, and when his report has been received it should be given local publicity. The official publication of the analysis—six months or a year later—is of no use."

I would suggest that in the interest of all concerned, that consumers, legitimate manufacturers, and county agents should promptly call the attention of the State Chemist and Sheriffs to all materials sold or offered for sale not bearing the guaranteed analysis and stamp required by law; sending samples and all pamphlets or letters, received by mail or otherwise, to the State Chemist.

Constant vigilance not only by officers, but by the consuming public, is necessary in order to protect the people of the State from such frauds. It is practically impossible for the very small force of inspectors employed by the State (the largest state east of the Mississippi River) to efficiently inspect the foods, drugs, stock feeds and fertilizers sold throughout the state.

Only the active co-operation of the legitimate manufacturers, the consumers and the public generally (as suggested in the American Fertilizer) can prevent such frauds, involving as they do not only vast sums of money, but also the failure of crops when such material, of little or no fertilizing value, is used.

The Children's Code Commission of the State of Florida

Miss Elizabeth Skinner, Dunedin.

There is one thing in Florida that I always uphold—the rights and protection of the flowers of the State—our children. It is to them that I am giving my effort and my time, so I ask the privilege of speaking to you on the Children's Code Commission. I feel that it ought to be of much interest to those interested in Florida. Our children are our most important crop. We are concerned with the development of all the children in the State —not just one group, but all the children, and this development depends upon the health of the children, the education of our children, and the kind of recreation they enjoy—just as our crops of fruit depend on soil, fertilizer and cultivation.

The health of the child is being taken care of readily by the State Board of Health. They are doing a great deal of work, and as fast as the public will co-operate, the State Board of Health is looking after the health of the children. This is adequately important, because you all know you spray your fruit, your oranges, you protect your other crops from any kind of disease in order that you may have a perfect crop, so in taking care of our children, if we take care of them during the first six years of their lives, we will have a perfect product in the end. That applies to their health, and mental and moral qualities.

The Children's Code Commission, also called the Florida Education Association, are looking after their education. A survey of our educational system in the State of Florida is to be made, if the Legislature so votes, which will make it possible for us to know just exactly what should be done to make our school A-1, second to none in the United States. That is the only way for Florida to take her place as a home for the people of the United States.

The next problem before us are the children below normal, below in health and in social reaction. We find that our Institutions who take care of the feeble minded and epileptics are so small, and the demand so great that the State is not meeting it in a way it should. It must either increase the capacity of the existing institutions by building more buildings, enlarging the staff of teachers, etc., or institute a Board of Child Welfare and Parole which will look to the prevention of juvenile delinquency. The least expensive program is the program of prevention rather than of cure. Many children could be paroled, and supervision of that parole would serve to make the

institution training effective, socially adjusting the child in a home and community, and individually strengthening his character.

Another phase of our investigation was an inspection of our State Institutions of Reform Schools. We found there the same thing—that the doors were crowded; that they could not take care of the children that were being sent to them or would be sent to them. We also found that there was no system of parole, no plan in the State of Florida so that these children were being kept in these institutions at an expense fifteen times as great as it would be if they could be paroled in their home or be well supervised in other homes. That would be a great saving to the State. We are recommending Probation because we feel that every child should be given a second chance to do what is right. Children are not bad, but often times they have the wrong environment, because of lack of control by institution or home, and lack of opportunity, and we want to have a Board of Child Welfare and Parole who will make it possible for every child to attend school—and get a schooling which offers it what it needs in every way, and we want to offer every child the proper recreation to which it is entitled. We then feel that the delinquency will be reduced.

We find that the records of the children committed to institutions mostly are due to truancy. There is something wrong at home that cannot control the child, or with the school that cannot control his interest. The child that has been sent through a court to school to get his education has run into something wrong somewhere. We want to find out what that is. If a child has to be forced to go to school there ought to be something done to relieve that situation. If it is a matter of health, a child who cannot keep up because of that, then a special opportunity should be given to that child. If we have to have a State Board of Child Welfare to accomplish this, let's have it. It will be economical in the end. Let's treat our institutions as a hospital for special treatment, and as soon as possible place that child in the environment in which he is going to become a high-minded citizen—not make hot-house flowers of our children, and when they go into society, have to be sent to our criminal institutions. Let us give our children a chance to grow up in a community in a normal way.

What are we going to do with the children that go to institutions for reform. Many states have worked out the plan of parole that has been successful—so that over 25 per cent of the parole has been successful in the highest sense of the word. I don't mean they have simply kept out of jail afterwards, and kept out of trouble. It seems to me we can profit by their experience, and have a system of parole in our State. A child committed to our institutions is committed there until he is 21. What good does it do to keep a child at an expense of $300 a year, if that child is not going to be better when he comes out. Unless we have a special fitted direction of health, education and psychology it isn't going to do the children a bit of good. They should be given special care and then placed back

in their own home, and if that home is not the sort of home they should be in, they can be placed in some other, where they can have normal life—a life of the school, of the church and take a part in all the social interest of that community.

That system in Virginia has reduced the waiting list of the boys and girls institutions so much that they have taken over the dormotories and built them into recreation hall and library, and other things, which goes to show that parole and probation are paying.

We can follow another method. We can build more buildings for our State to house these children that need special care, and keep them there as long as necessary. If a building costs $6,000, it's economical to build it. Then the care of seventy boys in one building would amount to $21,000 for one year. What we are proposing for the Board of Child Welfare and Parole is an appropriation of $20,000 per year, so you can see that amount is small compared to building one more building.

If you put your money into building boys and girls, making citizens of them, and it can be done—your money is better spent. You have something to be proud of. It costs less, and from the point of view of economy it pays to have a system of probation and parole. We all know how one decayed fruit can make the whole barrel or box decay. So if you keep one child in a community that is sub-normal or delinquent in any way, the others begin to catch the disease from it, and so we must have these institutions for the care of the children who cannot abide by our laws, but as soon as they can be brought back to health of mind and body they should be sent back to the community from which they came.

I appeal to you for a plan of prevention of delinquency, and of caring for our children. Let's spend all that is necessary for the care of these children, and let's spend all that is necessary for a cure, but let's spend the most of our money for prevention.

The Clonal Variety in Horticulture*

A. B. Stout, New York Botanical Garden

Nearly all the most important fruit crops, certain of the root and tuber crops, and a long list of the perennials familiar to the flower garden are propagated exclusively by vegetative means.

When the propagation is from roots as in the Sweet potato, from tubers as in the Irish potato, from the crown of the stem attached to the root as in the Dahlia, from bulbs or bulblets as in the Tiger Lily, from runners as in the Strawberry, or from cuttings as in the Grape, all the individuals (roots, stem, branches and all) of a variety are merely parts of one original seedling or bud sport. In the case of the propagation of the Apple, Peach, Plum, Cherry, Feijoa, Avocado, Orange, etc., by budding or by grafting, the trunks and the branches grown from the inserted buds or scions of any one variety are all sister branches. Thus all the many plants of the Concord Grape are branches derived from one seedling and the tops of all the Ruby Orange trees grown are the branches of one seedling plant. Except for bud variations that may have arisen in the course of the repeated propagations, all plants of such a variety are inherently alike with a constitution that is identical. In a sense, the entire variety is really one plant. Such a variety is known as a *clonal* variety in distinction from a variety grown exclusively from seeds as is one of the annuals of the field and flower garden. The distinction is readily evident and it is one of particular significance in regard to certain problems in the propagation, the culture, and the orchard management of crops.

There are two main advantages in clonal propagation. Usually it gives an easy and a quick means of propagation; for example it is by far much easier to obtain good plants from the runners of the Strawberry or from cuttings of the Grape than to grow them from seed. But a very important reason for propagating many horticultural crops by vegetative means is that the individual plants do not breed true to type from their own seed.

Undoubtedly, hundreds of seedlings of the Concord Grape, of the Bartlett Pear, of the Baldwin Apple, or of the Taft Avocado, could be grown without one producing fruit sufficiently similar to that of the seed parent to be marketed

*This address was illustrated by numerous lantern slides with comments and discussions that were not recorded and hence not available for publication. The main points of the address were however as here printed. This address first appeared in print in the Journal of the Horticultural Society of New York (vol. 4, pages 58-78, March 11, 1925) but it has seemed desirable to reprint it, without illustration and with a few changes in text, in this issue of the Proceedings of the Florida State Horticultural Society.

with it as one variety. In fact the majority of such seedlings yield fruit of poor and inferior quality and are judged unworthy of propagation and cultivation. In the development of varieties it is of distinct advantage when the rare seedling of special merit can be propagated vegetatively. Very often such propagation (grafting, budding, cutting, layering, root division, etc.) is the only way the individual plant can be perpetuated and increased in numbers. The individual is thus kept in existence and multiplied so that it may be distributed to many growers over a wide area and for an indefinite period of time.

Evidently this very practical and important lesson was learned early in the cultivation of fruit plants, for the first Greek writers on horticultural matters record that the art of propagation by grafting and budding was then already well understood. It appears, however, that during the Middle Ages this art was practiced chiefly as a cult or guild secret and was regarded by the uninitiated as the exercise of magic — a view quite in keeping with the spirit of that time.

Even within the memory of persons now living, prominent horticulturists have considered that grafting and budding are malicious practices which are perversions of nature and injurious to the plants thus propagated. But it is now recognized that the art simply takes advantage of the natural processes in the healing of wounds in plants. The art of grafting and budding is now taught in horticultural schools of every rank. It is widely practiced. The tricks of the art and the secrets of the propagators' guild are now the common property of all.

The merits of vegetative propagation of horticultural plants are now fully recognized. No one will advise a grower to plant an orchard of seedlings of the Apple, Pear, Orange, Lemon, Date, etc., or a vineyard of Grape seedlings. Also vegetative propagation simplifies the problem of developing new varieties. The problem in breeding is merely to obtain a seedling of merit; it is not then necessary to fix its type true to seed by long and laborious selection of seed progenies. The clonal variety immediately insures the greatest uniformity possible in propagation. The methods of vegetative propagation have become fully established in horticulture. The clonal variety has come to stay.

But clonal propagation involves and gives rise to certain problems and difficulties peculiar to itself. It has certain disadvantages, some of which may and do frequently defeat the very purposes for which the plants are grown. The horticulturist needs to recognize these, to understand them and to take measures to correct them, that the culture of clonal varieties of all the important fruits and perennial flowering plants may be made more nearly perfect in every detail.

PERFECTING MEANS OF PROPAGATION

For certain plants means of vegetative propagation remain to be discovered. Such a method has only recently been developed for the Para Rubber Tree. Undoubtedly, in time, methods of clonal propagation will be learned for nearly all perennials that are cultivated.

Methods of vegetative propagation now in use for various plants can no doubt be improved. It may not be possible to find better general purpose stocks for the fruits long propagated by grafting — Apple on French Crab, Cherries on Mazzard and Mahaleb stocks, Plums on Myrobalan stock, Citrus on Sour Orange and Rough Lemon, etc., — but for many fruit crops there is undoubtedly much to be learned as to how to secure the most congenial relations between scion and root stock and between the branching system and the root system of these dual individuals that are grown as one plant. Perhaps this may be advanced by a further standardizing of root stocks through their vegetative propagation. These are problems incident to the arts of propagation. They are primarily matters requiring the attention of nurserymen and of those growers who propagate their own nursery stock.

BUD VARIATIONS

In propagating clonal varieties nurserymen and growers of fruit and garden plants should be on the alert to correct any tendency to bud variation by giving proper attention to selection of buds or branches for propagation so that the standard type of the variety may be maintained. There appears to be a greater need for such selection in certain types of fruit, as the orange, than in others (apples for example). In many of the variegated ornamentals bud sporting is frequent, but is usually so conspicuous that it is readily recognized and taken into account.

Bud variations are not to be confused with those differences in character of foliage or fruit which arise when plants of the same clonal variety are grown under varied climatic and cultural conditions. They are most apparent when one or more buds on a plant develop into branches with foliage or fruit that is unmistakably different from the rest of the plant and when the propagation from such a branch gives a new variety.

Usually bud variations give aberrant types poorer than the type from which they come. Many cut-leaved types of ornamentals, certain varieties with variegated foliage, certain types of flowers as in Roses and in Chrysanthemums have arisen as bud sports. But very few noteworthy improvements in fruits have thus been obtained.

Selection of buds or propagating wood from the best and the most typical individuals of a variety is a sound and safe method in all vegetative propagation. This is particularly a detail to be handled by nurserymen. In respect to this matter the grower is wholly dependent on the nurseryman.

DISEASES THAT ACCOMPANY CLONES

It is becoming very evident that a clone should always be kept free from diseases that are transmitted from branch to branch on to new plants of the clone. It has been rather generally considered that clonal varieties tend to "run out." That they may do this by transmitting various infectious diseases and perhaps physiological disorders has now become apparent. Especially is this the case with Potatoes in which several types of infectious diseases may be transmitted to a healthy

plant and then carried in its tubers to the progeny grown from them. The successful growing of Potatoes, particularly, in the more southern states, has become in large degree dependent on securing for planting tubers of plants free from these diseases.

The recent advances in the knowledge of such diseases now make it very doubtful if vegetative propagation of itself ever leads to the "running out" of a clonal variety. The selection of healthy stocks in the various plants in which there may be yellows or mosaic disorders is becoming well recognized as a necessary procedure.

Rather special studies are needed to determine the nature of these diseases, the means of their transmission, and the methods of eliminating them in practical culture. Thus at the beginning the solution of these problems rests on the shoulders of the specialist in plant pathology. It remains, however, for the nurseryman and the grower to practice the means for control.

FRUIT PRODUCTION IN CLONAL VARIETIES

The horticulturist needs always to know when the growing of a clonal variety in solid blocks will of itself reduce fruit production through limiting the pollination required for the setting of fruit. It is the rule among the fruit crops grown at the present time that proper production of fruit depends on the development of seed. But the initiation of seed development depends (with few exceptions) upon intricate processes of fertilization which in turn depend upon a proper pollination. It happens that there are frequently special conditions that are inherent characteristics of certain clonal varieties which limit or prevent either pollination or fertilization after pollination whenever a plant stands alone or when there is a solid block of a single clonal variety.

There are so many conditions influencing the production of fruit that it is not always an easy matter to distinguish between those that are incidental, or purely environmental or cultural, and those which pertain to the needs of a variety for pollination. The former operate to limit production when all requirements for pollination are met. The latter operate to limit fruit bearing where all environmental conditions are fully favorable to high yields. The manifold and complex influences of climate, weather, culture, nurture, fungous diseases, insect pests, etc., are all of vital and immediate effect. They have always been matters of much concern to fruit growers. They always will be of much concern. But these are not factors for unfruitfulness that develop or become prominent because of vegetative propagation. They are quite apart from the unfruitfulness that arises from lack of pollination or from lack of proper fertilization.

Among the many cultivated plants (and wild as well) there are various types of sterility; the non-blooming condition, sterility from hybridity, and sterility accompanying double flowers frequently render plants decidedly or fully sterile in the true sense of the term. Such plants may be grown as ornamentals and be propagated vegetatively. Their sterility, however, does not arise because of vegetative

propagation or because plants are grown either singly or in clonal blocks.

With these eliminations, we may now make the inquiry: When does the growing of a clonal variety *of itself* reduce the fruit production of which the variety is capable? The answers may be stated as follows, embracing three groups of conditions:

1. When the variety has flowers that are entirely or decidedly pistillate — a grade of intersexes rather frequent in many kinds of plants.

2. When adaptations prevent or limit *both* self- and close-pollination.

3. When self- and close-pollination do *not* result in fertilization necessary for fruit setting.

These may be discussed briefly and in the order given.

INTERSEXES IN FRUIT CROPS

The Dates, Figs, Persimmons, Papayas, Strawberries, and Grapes illustrate well the fact that among the numerous individuals of a species or a race there are often different degrees in the relative development of the two sexes in the flowers which affect the ability to self-pollinate. These are deviations from the perfect type of flower with loss of either pistillate or staminate potency, giving frequently numerous grades of *intersexes*. The ability to bear fruit is limited to those individuals or clonal varieties that are more or less potent in femaleness and in these there is the possibility of self- or close-pollination only when stamens or staminate flowers are also developed. Otherwise there is need for cross-pollination. In such plants the problems of fruit setting, as far as pollination is concerned, are solved either by hand pollination as in dates, by supplying pollen-bearing flowers together with the insects to carry the pollen as in the Smyrna Fig, by proper interplanting of pistillate with either male or perfect-flowered plants as for certain varieties of Strawberries and for Muscadine Grapes, or in the development of perfect-flowered and self-pollinating varieties as was done in the Strawberry and is now being done in the Muscadine Grapes.

A lesson in respect to this type of sterility may be learned from the recent experiences with the J. H. Hale Peach. Highly productive of excellent fruit in nursery and orchard trials when surrounded by other varieties, it was extensively advertised and heralded as "the million dollar Peach." When solid blocks of this clonal variety came to the age of yielding fruit it was found that many of the fruits were undersized, poorly colored and insipid, and that many such fruits fail to mature. Examination showed that the decided self-unfruitfulness of this Peach is due to its poor pollen. To obtain the good yields of fruit which this variety is capable of bearing it is necessary to interplant it with other varieties that yield good pollen in abundance. Peaches are as a rule perfect-flowered, self-pollinating and highly self-fruitful. This variety is hence an unexpected exception which arose and caused considerable financial loss to those who planted it in solid blocks.

In general it may be said that self-unfruitfulness of an intersex plant or its

clonal variety arises because its flowers are imperfect and do not supply viable pollen suitable for any sort of fertilization.

In certain cases, as for some varieties of Strawberries, an examination shows the absence of stamens. In other cases the stamens may be present, and may shed pollen, but adequate examination under a microscope together with tests for viability will readily reveal the impotent condition of the pollen.

ADAPTATIONS LIMITING SELF- AND CLOSE-POLLINATION

The mention of adaptations for cross-pollination naturally brings to mind the many varied and marvellous structural adaptations for "cross-pollinations" by insects. But no matter how complex these may be, as long as the flowers of the different individuals of a species are *alike* and as long as there are numerous flowers open on a plant at the same time structural adaptations of themselves do not prevent close-pollination (from flower to flower on the same plant or from plant to plant of a clonal variety.)

To take a seed-grown variety to illustrate this point, it is mechanically as easy for a bumble bee to carry pollen from the stamens of a flower on a Red Clover plant to the pistil of another flower on that same plant as it is to carry such pollen to a flower of another plant and the chances for doing so are greater. Adaptations which limit self-pollination do not necessarily restrict close-pollination. In such cases the agent effecting close-pollination becomes an important factor in pollination, but the planting in solid blocks of such a clonal variety does not complicate or limit the possibility of the action of this agent. With the adequate operation of the insects, either a single plant of the Red Clover, or a solid block planting with one clone of the Red Clover, or a planting with every plant a different seedling would be pollinated equally well. Without any action of insects there would be the same restriction in fruit setting, provided, of course, that the factor deciding the setting of fruit is solely that of pollination.

But structural adaptations may advance in complexity until close-pollination is also restricted. In certain Primulas, Lythrums, and Orchids there are different forms of flowers for individuals or for groups of plants. These are such that it is mechanically easier for insects to effect certain "legitimate" cross-pollinations. In such cases the exclusive growing of a clone having one form of flower tends to reduce pollination. It appears, however, that such a specialization does not exist to a marked degree in any of the important fruit crops at least in those grown in temperate regions or that have perfect flowers.

What has just been said regarding structural adaptations for cross-pollinations applies as well to those adaptations in which the pistils and stamens in individual flowers mature at different times (condition called dichogamy). In most plants, dichogamy prevents self-pollination but not close-pollination. Thus in the single-flowered types of the garden Geraniums the stamens of a flower shed pollen considerably in advance of the maturity of the pistil of that flower. But there are usually flowers of various ages

after opening on the plant, so there is a chance for insects to carry pollen from flower to flower on a plant or from plant to plant of one clonal variety. There is, hence, a pollination problem and the action of insects is necessary to effect pollination, but the growing of a clonal variety does not make it the more difficult. In most fruit crops, Apple, Pear, Peach, etc., there is a partial dichogamy, but the pistil of a flower, as a rule, remains ready for pollination until after the pollen is shed from some of the anthers of the flower, so there is opportunity for self-pollination. Also in these fruits there are flowers of all stages of development open at the same time during most of the period of bloom, so there is abundant opportunity for close-pollination by action of insects. As far as pollination is concerned the clonal variety of such a plant may be planted in solid blocks.

But dichogamy may be so highly specialized that close-pollination is also restricted, as is the case with Avocados. In this plant the flowers are perfect, but each flower has normally two distinct periods of opening. The pistil of a flower is ready for pollination at the first time the flower opens, but it is only during the second period of opening, at least 14 hours later, that the pollen is shed. This prevents self-pollination. But the flowers of a tree, or of trees of a clonal variety, open and close together for each of the two periods of opening. Flowers of a kind in the same period "flock together" andthis daily rhythmic synchrony restricts close-pollination. It will readily be seen that if all Avocados (seedlings, clonal varieties, etc.,) have the same daily sequence, cross-pollination among Avocados would likewise be restricted. But a survey of the varieties shows two main types of daily sequence. In one group of varieties pollen is shed in the forenoon and first-period flowers ready for pollination are open in the afternoon. In the other group the behavior of flowers is in the reverse order. The two types supplement each other. The time relations are wonderfully adapted for cross-pollination between individuals of the two groups. Solid block plantings of a clonal variety or mixed planting of varieties that have the same daily sequence of bloom will decrease the chances for pollination. The Avocado is a conspicuous case showing that the flower behavior of a new type of fruit crop and its requirements for pollination should always be determined before clonal varieties are planted in solid blocks.

WHEN SELF- AND CLOSE-POLLINATIONS DO NOT RESULT IN FRUIT

Self-fruitlessness exists in such clonal varieties as the Napoleon Cherry, the Bartlett Pear, the German Prune Plum and the Rhode Island Greening Apple and in many other varieties of these fruits. Each of these has perfect flowers with stamens fully developed and with pollen highly potent. Each is known to be capable of yielding heavy crops of fruit. There are no marked differences in the time of the development of the pistils and stamens of the individual flowers. The flower mechanism does not prohibit self-pollination even without insect visitations, but with such visitations close-pollination is amply provided for. And yet

these self- and close-pollinations are not effective in fruit setting. There is what we may call an incompatibility in the processes of fertilization which follow pollination. Interplanting is hence necessary to provide for the pollinations which *do result in fertilization.* But there may also be cross-incompatibilities: two well-known varieties of sweet cherries, the Bing and the Napoleon, are reported to be not only self-incompatible but cross-incompatible as well.

It is to be noted that incompatibilities are not to be determined by an examination of the flower, or by any laboratory tests of the pollen, as pollen sterility in intersexes may often be determined, but only by the results of properly controlled pollinations combined with the results obtained in orchard plantings.

It is now evident that many varieties of Apple, Pear, Cherry, Plum, Blackberry, Almond, and Feijoa are self-incompatible to some degree. Certain varieties of these fruits, of which the Wealthy apple may be mentioned, appear to be rather highly self-compatible, but in many cases even these varieties will produce larger yields of better fruit when there is cross-fertilization.

During the past ten years, especially, evidence has been accumulating as to what varieties of our fruits are or are not self-fruitful. The evidence is very often conflicting and this has been accepted by most horticulturists as proof that "self-sterility is not a constant factor in any variety." It is said that "the same tree may be self-sterile at one time and self-fertile at another or the same variety may be self-fertile in one locality and self-sterile in another." Such behavior is credited to important varieties as the Kieffer and Bartlett pears and the Yellow Newton and Rhode Island Greening varieties of apples. No doubt in many instances other causes of unproductiveness are wrongly attributed to self-incompatibility and also that cross-pollination may have occurred where it was not expected. It is not at all certain that the differences in fruit production observed in these cases were due to variations in the one factor of self-fertilization. But unless experience shows that a clonal variety of these much cultivated fruits is decidedly fruitful, the safe course for the grower is to interplant rather liberally.

Perhaps an important advance in horticulture will be the combining of a high degree of self-compatibility with high quality of fruit and other desirable qualities through further breeding of all of the various fruit crops in which incompatibilities are now marked. This would allow solid block plantings with the advantages in orchard management that this brings. It would make yields of fruits less dependent upon insect pollination in that the self- and close-pollinations would be sufficient.

But possibly the ultimate and most ideal goal of the horticulturist is to develop fruits like the Navel Orange which mature fruit without any pollination; the problems of pollination and fertilization are then entirely eliminated in the matter of securing yields of fruit.

It is to be emphasized that the abundant yields of fruit by a new seedling or by plants vegetatively propagated from it when grown in trial orchards or nursery

plantings when *surrounded by other varieties is no test for self-fruitfulness.* This simply shows that the plant or the clonal variety is able to *produce* fruit. Whether the plant is a female intersex, whether there are structural adaptations or dichogamy limiting both self- and close-pollinations or whether there are self-incompatibilities is not in the least revealed. There is no evidence from this as to what the pollination or fertilization requirements are or of how the variety will yield when planted alone or in solid blocks.

The ideal plant for vegetative propagation and for solid block planting from the standpoint of consistent yields of fruit is one that is *self-fruitful.* For it to be thus, it should have perfect flowers, there should be no structural or developmental adaptations that decidedly limit close-pollination at least and preferably self-pollination also, and the self- and close-pollinations should be compatible in fertilization to the point of producing fruit. The characteristics of a variety in all these particulars should be fully determined before it is distributed and widely planted.

The four groups of horticultural problems briefly outlined above are those that are peculiar to vegetative propagation and to the growing of clonal varieties in solid blocks. They refer in part to the special problems of the nurserymen in their efforts to develop and to use the best methods of propagation and of maintaining varieties true to type; they refer to critical problems in fruit production which the grower frequently meets when he plants a clonal variety in solid blocks, and they refer to certain important phases in the breeding of new varieties for the quality of self-fruitfulness.

Clonal propagation now plays an important part in horticulture. It is destined to increase in importance. With due regard to their respective responsibilities, the breeders of horticultural plants, the nurserymen who propagate them for the trade, and the orchardists who grow these plants for their products can speed the day when the clonal variety presents no serious defect or at least gives rise to no problems that are not met.

The Flower Behavior of Avocados with Special Reference to Interplanting

A. B. Stout and E. M. Savage

With a selection of varieties on the basis of their relative flower behavior, interplantings of avocados can be made which will greatly increase the chances for the proper pollinations necessary for fruit production. It is the purpose of this report to present records of the flower behavior of numerous varieties which indicate why interplanting is desirable and how the selection of varieties for the most successful interplanting is to be made.

With the exception of the variety Collinson, to be discussed later, all varieties and seedlings thus far studied by the writers, have flowers that appear to be fully perfect. They shed pollen under favorable conditions of weather and they appear, with possibly a few exceptions among seedlings, fully able to function in the development of seed and fruit. But in avocados self-pollination of individual flowers is, for most varieties at least, greatly restricted or even impossible. Each avocado flower has normally two distinct periods of being open. It is during the first period that the pistil of the flower is most ready for receiving pollen but it is during the second opening that the pollen is shed. The appearance of the flower during the two openings is indeed very different. At the climax of the first opening the pistil stands erect and alone and the stamens lie at right angles to its base.

During the second opening the stamens are decidedly larger, they stand more nearly erect and the valves of the anthers open, bend upward and carry out the pollen and then insects may complete its distribution. The length of the interval between the closing after first-opening and the shedding of pollen in the second-opening differs for varieties. When this interval is from 12 to 16 hours as in the Trapp, some pistils may remain in a condition suitable for fertilization by self-pollination. But for many varieties the climax of the maturity of the pistil of a

*This report pertains particularly to studies made in Florida during February and March, 1925, in which Dr. A. B. Stout of the N. Y. Botanical Garden and Mr. E. M. Savage of the U. S. Department of Agriculture co-operated. The expenses of Dr. Stout were met by Dade County through its Farm Bureau. The County Agent, Mr. J. S. Rainey, various officers of the Florida Avocado Association and numerous growers of avocados co-operated very fully in the investigations. This report also draws freely of previous studies by the authors, those of Dr. Stout in California in the Spring of 1923, and those of Mr. Savage in Florida during the Spring of 1924. Certain portions of this report and especially the discussion of interplanting draws freely and to the point of exact quotation from articles previously published. The plan has been to assemble in this one article all the most important data now available on flower behavior of avocados with advice regarding interplanting.—*The Authors.*

flower, 24 or more hours before the pollen of that flower is shed, obviously makes self-fertilization of individual flowers impossible.

In a report concerning avocado cross-pollination made in Florida during April 1916 for the U. S. Department of Agriculture mention was made of the opening of two sets of flowers each day, one in the morning and the other in the afternoon. Many points concerning avocado flowers and their behavior were recorded in this early report. Had individual flowers been tagged to better observe their behavior, the differences in them during the two open-periods of each flower, with the intervening closed period, would no doubt have been discovered at that time.

Close-pollination is also greatly restricted. The possibility of pollen being carried from a flower shedding pollen to a first-period flower of the same tree (inter-period close-pollination) is most decidedly limited. The rule of behavior is that only flowers of the same period-opening occur together on a tree at one time.

Thus during the entire forenoon only first-period flowers will be found open on a tree of Taylor. About noon these flowers close fully and another set of flowers will open for the second time, and this is a set that opened for their first-period on the forenoon of the previous day. During the afternoon these flowers shed pollen. They are unable to self-pollinate properly for their pistils were most ready to receive pollen some 28 hours before. There are no first-period flowers open on the tree to which their pollen can be carried. This daily alternation in the character of the flowers occurs day after day with such precision that the chances for proper cross-pollination are indeed slight. The tree is really female in the forenoon and male in the afternoon!

A tree of Panchoy may be growing by the side of the Taylor tree. Observations of its flower behavior will reveal a daily periodicity or alternation of the sets that is exactly the reverse of that in the blooming of Taylor. During the forenoon only second-period flowers are open.

During the afternoon only first-period flowers are open. Thus the tree is male in the forenoon and female in the afternoon. Its flowers are unable to self-fertilize or to close-fertilize.

Obviously the flower behavior of these two varieties affords opportunity for abundant cross-pollinations both ways between the two trees. In the forenoon pollen may be carried from Panchoy to Taylor and in the afternoon there is opportunity for pollen to be taken from Taylor to Panchoy. But if either tree stands entirely alone, with no other variety of avocado near or within insect range, there is very little chance that there will be pollination at the proper time.

A further point of special significance is that the growing of a solid block of trees of any variety of avocado tends to isolate the trees and to reduce the chances for proper pollination. The avocado is propagated vegetatively by budding or grafting. Thus all the many plants of any one variety are, in reality, merely branches of one original seedling plant. They all have the same flower behavior. When planted in solid blocks they all pass through the same daily sequence in the opening of flowers for the two periods. Their flow-

ers all shed pollen during the same hours and they all have first-period flowers open together during other hours. Reduction in the yields of fruit, in solid block plantings, is to be expected. It is the interplanting of trees of different varieties which have a reciprocating alternation (such as Panchoy and Taylor furnish) that provides the chances for the greatest number of proper fertilizations through cross-pollination.

In regard to flower behavior, all varieties and seedlings of avocados thus far studied by the authors in California and in Florida are to be grouped into two main classes.

In one class, which may be designated Class A, the first-period flowers normally open in the forenoon and close during midday to remain closed about 24 hours. Each afternoon another set of flowers opens to shed pollen. Taylor mentioned above is typical of this class.

In the other group of varieties, Class B, the second-period flowers are normally open during the forenoon and the first-period flowers are open during the afternoon. Panchoy is in this class. fffff

This natural grouping of varieties into two classes is readily revealed when one makes observations on the flowers of several varieties at frequent intervals during a single day of favorable weather. Tagging and numbering individual flowers greatly facilitates the observations for otherwise the shift of sets may not be discovered.

A chart of the records of flower behavior for one entire day of favorable weather clearly indicates several important facts, namely:—

1. That for each variety there are normally two different sets of flowers open during the day.

2. That the first-period flowers on a tree open together and for different hours than do the second-period flowers.

3. That the various varieties fall into two general classes with reference to the daily sequence of the two sets of flowers.

4. That the flower behavior of avocados is decidedly adapted to cross-pollination between varieties which shed pollen in the forenoon and those that have first-period flowers open during the forenoon.

Cloudy and rainy periods of weather and particularly low temperatures greatly affect the opening and the closing of flowers. Such weather throws the sequence of blooming out of stride and the flowers of one or more sets of a variety may behave with marked irregularity. The first period of opening may be omitted by an entire set. Sets of second-period flowers may fail to shed pollen. A set that normally would open in the afternoon may be retarded until the following forenoon and the firsts of that forenoon may be retarded until afternoon, temporarily, giving a reversal for the normal daily sequence of the variety. Three distinct sets of flowers may be open during a single day.

Frequently during irregular and off-stride blooming there is an overlapping of different sets and first-period flowers may be open at the time second-period flowers are shedding pollen. There is then an opportunity for close-pollination. When a set of flowers skips the first-period and has a single opening during

which pollen is shed there would seem to be opportunity for self-fertilization of individual flowers provided the pistils have remained receptive to the pollen. There is, however, some question as to what extent off-stride flowers can function in fertilization and fruit setting. Certain varieties appear to be rather subject to overlapping and in some of those that open the first-period flowers in the forenoon this may be sufficient for some setting of fruit to close-pollination.

Class A. Varieties which normally have first-period flowers open in the forenoon and second-period flowers open in the afternoon.

G	Atlixco	W	Family	G	Sinaloa
W	Baker	EM	Gottfried	G	Solano
	Baldwin	EG	Grande	G	Spinks
G	Benik	W	Hawaii	G	Taft
G	Blakeman	LG	Kanan	G	Taylor
	Brooks	G	Kashlan	GWHy	Taylorson
W	Butler (SPI 26690)	MGHy	Lula	G	Ultimate
G	Cantel	G	Manik	G	Wagner
		G	Mayapan	W	Waldin
G	Challenge	E	Moanaloa	W	Wester
	Clower	G	Murrietta Green		SPI 18729
WGHy	Collason No. 1		Murrietta 2-lb.	M	SPI 19206
WGHy	Collason No. 2	G	Perfecto		SPI 26698
WGHy	Collason No. 3	W	Pinelli		SPI 26703
WGHy	Collinson 1 (No pollen)		Popenoe No. 3		SPI 29137 Trapp Sdl.
WGHy	Collinson No. 2	EM	Puebla		SPI 29379
G	Colorado	Hy	Reasoner		SPI 44626
G	Dickinson		Richardson	W	Seedling 1-2
G	Dickey	LG	Sharpless	W	Seedling 1-6
G	El Presidente	W	Simmonds	W	Seedling 4-5

Class B. Varieties which normally have first-period flowers open in the afternoon and second-period flowers open in the forenoon.

G	Akbal	W	Golden (Taft's)	W	Pollock
	Butternut		Hanson	G	Queen
G	Cabnal	W	Hardee	LG	Rey
	Cardinal (26699)	EG	Harmon	M	Rome (SPI 34831)
G	Champion	G	Ishim	EM	San Sebastian
G	Chisey (Pop. No. 11)	G	Ishkal	G	Schmidt
LG	Coban	G	Itzamna		Stephen's Choice
LG	Colla	LG	Knight	G	Surprise
Hy	Collason x Trapp	G	Lamat	G	Tertoh
	(SPI 61740)	G	Linda	W	Trapp
Hy	Collason x Trapp	G	Lyon	G	Tunim
	(Broad-leaf)		Mattair	G	Verde
LG	Collins	W	McClure	G	Walker
LG	Cook	LG	McDonald	W	Whitcomb
G	Dorothea	G	Meserve	G	Winslow
G	Eagle Rock	G	Montezuma	GWHy	Winslowson (Rolf's)
W	Earle's Late (26692)	G	Nabal	Hy	Winslowson x Trapp
LG	El Oro	G	Nimlioh	W	SPI 26689
W	Estelle	GWHy	Nimliohson		SPI 26700
G	Fuerte	EM	Northrup		SPI 32400 Seedless
	Fulford (26707)	G	Nutmeg		SPI 44856
M	Ganter	G	Panchoy	M	Seedling 12-7

A record for the month of February 1924 shows very much more off-stride blooming and overlapping of first- and second-period sets of flowers, with much more opportunity for both self- and close-pollinations on many varieties than was recorded during the spring of 1925. The cooler and more changeable temperature in 1924, were, no doubt, accountable for this difference in flower behavior. Certain varieties had much more opportunity to set fruit to their own pollen, but as a matter of fact, these certain varieties yielded one of their lightest crops.

A group of varieties of which Pollock, Trapp, Estelle and Taft's Golden are conspicuous examples, have the first-period opening late in the afternoon. They do this consistently day after day. This set may not open until after dark and it may frequently be skipped even on days when numerous other varieties of the A and B groups complete the daily cycle of two sets with decided regularity. When these same flowers open on the following day to shed pollen their pistils are often still white. It seems highly probable that at least some of such flowers may be able to self-fertilize.

Thus the setting of fruit by isolated trees or by trees of a solid planting of one variety and particularly by trees abundantly worked by bees in tenting experiments may be expected. It is possible that a peculiar set of local weather conditions may sometimes favor setting of fruit year after year without cross-pollination. Some varieties such as the Trapp may have a flower behavior that enables them to be more self-fruitful than are other varieties. But even for such varieties there is no doubt that a proper interplanting will increase the chances of many more proper pollinations and to this extent insure the production of more uniform crops.

The varieties are here arranged alphabetically in two groups. The upper group is made up of those which normally open their flowers for a first time during the forenoon and shed their pollen from another set of flowers open for a second time during the afternoon. The lower group is composed of varieties which have a reverse order of flower-opening behavior. These have flowers open for a first time in the afternoon and for a second time, shedding pollen, during the forenoon.

In the above list those varieties of Mexican origin have been marked with an "M," while "W" indicates West Indian, "G" Guatemalan and "Hy" Hybrids. "E" marks the varieties which start their blooming period early in the season and "L" those which are late in doing so. The early varieties are either all through with their blooming period, or are nearly through, before the late varieties start to open any flowers at all. Hence increased fruit production cannot be expected from an interplanting of an early blooming variety with a late one.

The varieties listed in these two groups are thus placed after careful observations on their flower behavior were made either in California in 1923 or in Florida in 1924 and 1925. A daily record continuing over many days was kept of most of the varieties and observations were made on a number of trees of each variety. A few varieties of lesser importance, however, are included where only one tree was

available for study, or where observations were made on only one day. In some of these cases the identity of a tree may be in error as seems to be the case of a single tree called El Oro, which was studied in California in 1923.

The variety Collinson appears to be completely sterile as a pollen parent. The flowers have two periods of opening. The second-period flowers open in the afternoon but the anthers remain closed and no pollen is shed. Observations have been made of the flowers on the original tree of Collinson, on some of the first trees propagated from its buds and on about thirty others of blooming age in grove plantings. On some of these, observations were continued day after day over a period of more than two weeks. In two instances a single anther valve was found lifted but no pollen was found. An examination of the flowers closed after the second opening shows that the anthers had shed no pollen after the final closing. This variety appears to be completely impotent as a pollen parent. It sheds no pollen for any sort of pollination. Fruits maturing on it are the results of cross-pollination.

A glance over the various charts shows a noticeable difference between the different varieties as to the hours of a single day when the two sets of flowers are open. Thus for the varieties studied on February 24th, there was a difference of two hours between the time when firsts opened on Perfecto and the time when the set of firsts started to open on Pinelli. A still greater difference is seen in the time when firsts started to open in the afternoon. There are also variations in the time when seconds were open and for the period when they shed pollen, but this is more nearly the same for the various varieties of a group (A or B) than is the period of the opening of the firsts. These relative differences continue day after day. Atlixco and Perfecto open their first-period flowers early, Taft and Wagner late.

For the varieties in Group B, Meserve and Panchoy have firsts relatively early in the afternoon in comparison with Pollock, Trapp, Estelle and Taft's Golden. For the varieties opening firsts late in the afternoon there is, under normal conditions, a distinct period of one or more hours between the time when second-period flowers are fully closed and the time when the firsts begin to open. It is to be noted that none of these late-opening varieties of the B group were available for study in California so the records of flower behavior obtained there show less variation among varieties.

The observations both in California and Florida indicate that the varieties of the B class exhibit the greatest irregularity and off-stride behavior under unfavorable weather conditions. Weather which merely delays the opening of the two sets in varieties of the A group will often cause various varieties of the B group to continue a set of firsts open over night and into the next day, or to skip the set of firsts, or to have them open for a period during the night. The second opening of a set, or part of a set, may be delayed until the second day giving an interval of about thirty-six hours between the closing of firsts and the opening of seconds. For some varieties this interval of thirty-six

hours seems to be almost a regular or normal behavior.

Under decided changes in temperature the blooming of all varieties is thrown off stride. The role which such irregularities play in fruit setting remains to be determined. Changes in weather which do not noticeably produce off-stride behavior of flowers will frequently produce differences from day to day of one or more hours in the time of opening. In such cases the relative behavior of different varieties remains quite the same. When this behavior is charted for a number of varieties it is as if the entire chart of one day is moved over to later or earlier hours.

As the season of blooming advances and there are more hours of sunlight with higher temperatures the periods of flower opening advance to earlier hours. Thus a day's record during the best weather of February may be two or more hours later than a day in March or April. This change to earlier hours as the season advances is also well shown when the records for a single variety for different days in the season are compiled in a single chart. While there are marked variations from day to day due to changes in weather there was a general trend to earlier hours as the season advanced. The record for Trapp, however, shows scarcely any tendency to such a shift to earlier hours.

COMMENTS ON INTERPLANTING

The aim in interplanting avocados is to provide for cross-pollinations which will increase the yield of fruit beyond that obtained or possible in solid block plantings of single varieties. On the basis of flower behavior, already discussed in this record, it seems certain that proper interplanting will provide the opportunity for cross-pollination and should increase production and make it more uniformly certain. It seems quite probable that without cross-pollination many varieties will be shy bearers or even non-fruitful.

Apparently avocados have hitherto been planted with little, if any, though of any necessity for cross-pollination. The results fully condemn this practice. Plantings of many varieties have often given scanty yields of fruit, particularly when there have been solid blocks of one sort, and when the general conditions of culture, weather, etc., were evidently highly favorable to the production of fruit. For the greatest success in avocado culture, the difficulties due to insufficient pollination should be reduced to a minimum. Other matters of importance bearing on fruit production, such as bud selection, methods of culture, nurture of (artificial fertilizers) etc., may then be determined with greater certainty.

The selection of varieties most desirable for culture involves many matters such as the habits of growth, adaptability to local conditions of soil, climate, fungus diseases and insect pests, and the quality of fruit and its season of maturity. These are matters which the grower must consider in deciding what varieties are most worthy of culture. When this selection is made the question of interplanting to be considerd is how the varieties selected are to be arranged in the planting and if other varieties are needed as proper pollenizers.

The one aim in interplanting avocados

is to increase yields of fruit. Whether an interplanting will do this or not depends mainly on three conditions pertaining to pollination.

1. The interplanting must provide opportunity for an increase in the number of proper pollinations that are possible.
2. Means for effecting these pollinations must be provided and must be working year after year.
3. The pollinations when made must be compatible for fertilization and hence result in the setting of fruit.

These three matters may be considered in the order stated.

1. What interplanting will increase the opportunity for a greater number of pollinations? Any interplanting of two or more varieties will do this if they supplement each other in the daily sequence of the opening of first-period and second-period flowers, provided of course that they are in flower together or over a considerable span of calendar dates.

For example Taylor and Panchoy meet this requirement very well. They bloom together at least for a considerable period. Day after day in the forenoon many and even thousands of first-period flowers of a tree of Taylor are open and ready for proper pollination, during the hours when a tree of Panchoy is shedding pollen from second-period flowers. In the afternoon the conditions are reversed. When trees of these two varieties, or of other similarly reciprocating pairs or combination of two or more pairs stand side by side there are many more chances for proper pollination than can possibly exist when trees of any one of the varieties stand alone or in solid blocks. *The chances are probably increased a thousand times.*

The first principle, of interplanting, is, therefore, that varieties which normally have first-period flowers in the forenoon should be planted with varieties which shed pollen in the forenoon.

A further selection may, however, be desirable. As amply shown and discussed above, there are varieties that are characteristically early or late in the daily periods. This suggests that some pairs selected from the A and B groups may be much more fully reciprocating than are other pairs.

2. An interplanting can only afford or supply the chances for cross-pollination. Means for effecting these cross-pollinations must then be operating. Insects are without a doubt the natural agents for the pollination of avocados. Wind plays, or seems to play no important role in the distribution of the pollen.

Fortunately honey bees are very fond of avocado nectar. They freely visit the flowers during both periods of their opening. In California they were frequently found in great numbers working avocado flowers. In Florida wherever bees were kept in groves or near by, they were found among the avocado flowers, but as a rule, during the past season the writers seldom saw many honey bees in the avocado trees. It is highly to be recommended that avocado growers keep bees. Insects other than bees, such as wild species of wasps, flies and thrips are frequently found working avocado flowers. Some of these may be important agents in pollination.

It must be noted that in effecting cross-pollination insects must fly back and forth repeatedly between trees of reciprocating varieties. If individual bees or other insects confine their visits to the flowers of one tree or to trees of one variety the interplanting will be of no special advantage. Possibly the quality of the nectar produced by various varieties may influence the activities of bees. There may be such differences in the flavor and odor of nectar produced by certain varieties that individual bees may refuse to fly back and forth between them and collect nectar from both.

The whole matter of the behavior of bees and other insects in the pollination of avocados and especially in extended plantings of them deserves a very careful study. Insect behavior is without doubt one of the deciding factors as to the results obtained in interplanting.

3. When pollinations are made at the proper time and in the proper way fruit does not necessarily start to develop. In numerous fruit crops, apples, pears, plums, cherries, etc., certain pollinations are not compatible in fertilization and hence do not lead to the setting of fruit. Usually it is self-compatibility that is not effective and this limits or entirely restricts self- and cross-pollinations as fully as does the flower behavior in avocados.

Sometimes cross-pollinations between varieties of the same fruit also fail and so differences in affinities of fertilization may exist between avocado varieties. Certain results in Florida have led some of the growers of avocados in the state to consider it possible that interplanting West Indian and Guatamalan varieties is especially productive of good yields. In California, many controlled cross-pollinations were made between varieties in the hope of obtaining some evidence on this matter of affinities in fertilization. Most of these pollinations were made during the months when there was much irregular and offstride blooming and the percentages of "sets" were too low to be reliable in judging the matter.

In Florida, no fruit developed to either self- or close-pollinations artificially made during 1924. From hundreds of flowers artificially self- and close-pollinized during February and March 1925 only three close-pollinations were holding March 28, while eight fruits were holding from the cross-pollinations made prior to March 17. Between March 17 and 28, 562 flowers were cross-pollinized in 35 different ways, using 13 different varieties of flowers and 14 different kinds of pollen, from which some interesting data may be obtained.

Undoubtedly certain varieties will cross-fertilize more readily than others even when there are equally good chances for cross-pollination. It would be well worth while to determine this by appropriate experimental tests.

It is to be recognized that at the present time there is no rule of thumb for the interplanting of avocados which will guarantee unqualified success. In respect to the behavior of flowers, alone one can have no hesitancy in advising interplanting for every variety and of making the choice of various pairs of varieties which will provide the chances for greatly increased pollinations. Any interplanting on this basis is better than none at all!

It would undoubtedly be good business for avocado growers and nurserymen to perfect plans for determining as quickly and as exactly as may be possible the various combinations of interplantings most favorable to fruit setting. Without this it is up to the grower to interplant the varieties which he wishes to grow on the basis of their relative flower behavior and to supply bees in abundance, placing them among the avocado trees during the blooming season.

The accumulated results of such plantings will no doubt in time reveal what varieties will work best together and also clear up many points regarding the way the interplanting should be arranged.

It may be noted that interplanting aims to correct fruitlessness that is due to faulty or inadequate pollination. The manifold cultural and environmental conditions which affect or determine the production of fruit must also be met. They exist quite apart from the problems of pollination and they may very frequently limit production of fruit when all the conditions for proper pollination are satisfied.

There appear to be few legitimate objections to the interplanting of avocados. It seemingly entails no vital problem in culture. No very serious difficulties would be involved in the picking and grading of fruit. To grow two or three different varieties on one trunk will require the use of varieties which will grow together and make a well shaped tree, but this may not be necessary.

Finally it may be said that in making interplantings along the lines which now seem most promising the grower has nothing to lose and there is the chance that he will gain something worth while. He may not immediately hit upon the best combination which fills the bill in all three particular—i. e. (a) gives chance for proper pollination, (b) encourages and facilitates cross-visitations of bees and (c) involves strong affinities in fertilization — but this much is certain, he will be no worse off than if he planted in solid blocks. He simply plays a game in which he has nothing to lose but stands a good chance to gain.

TENTING EXPERIMENTS

Experimental evidence as to what extent trees of different varieties of avocados are self-fruitful is one of special interest and of practical bearing on the planting of varieties in solid blocks. Whether proper pollinations for fruit setting, either self or close, are possible and if so for what varieties and for what types of flower behavior are matters which should be determined.

During the past season some evidence bearing on these questions, was obtained by tenting experiments, conducted near Homestead, Florida, in the groves of Mr. W. J. Krome, who for years has been a leader in efforts to solve avocado problems. In these experiments a tree of each of the varieties Linda, Panchoy, Taft and Trapp was entirely covered with a tent in which a hive of bees was confined. It was the plan thus to supply abundant or even excessive means of pollination. Probably this was far beyond that possible in open orchard practice.

A frame of 2x4 timbers was erected on a base of 2x6 timbers and firmly braced. Furring strips were nailed to the

sides and top, to which cheese cloth (Curity Absorbent, "1A") was overlapped and nailed under lath. The four tents were completed before there was any bloom, except that on the Trapp and Panchoy a very few flowers had opened and these were removed, The tents were all completed and the bees inclosed on or before February 28th.

The bees were furnished by Mr. E. P. Goldberg, who made frequent trips and observations regarding their welfare, feeding them with honey as seemed necessary. By the first of March the trees of Panchoy and Trapp were in fair bloom. On March 25 Panchoy and Trapp were in heavy bloom, Taft in good bloom and Linda in light bloom. Throughout the flowering of all the trees the bees in every tent worked the flowers hard. Good weather with sunny days prevailed and the bees continually worked flowers of both sets. On March 29th Dean Wilmon Newell of the Florida State Agricultural Experiment Station made observations on the conditions and remarked on the excellent and abundant visitations which the flowers were receiving from the bees.

The selection of the four varieties was made with special intent. Taft is, as the record of flower behavior shows, a variety typical of Class A in flower behavior with a long interval (24 hours) between the closing of the firsts and their opening for the second time. Besides it is a well known commercial variety that has a reputation of being a shy bearer.

The other three varieties, Linda, Panchoy and Trapp are all members of Class B with firsts normally opening in the afternoon. Linda and Panchoy are among the varieties of the B Class whose firsts complete their period regularly and comparatively early. Trapp is much later, frequently skips the first opening and is a widely cultivated variety and has the reputation of being a consistant and heavy bearer. It would seem that if any varieties can set fruit to selfing, it will be those that open firsts late as does the Trapp.

Mr. Barney: I would like to ask these gentlemen one question. In mixing up this planting, would it be in accordance with their investigation if each tree planted had one or two grafts of average varieties on the same tree?

Mr. Savage: The matter of grafts upon the same tree is one which will depend entirely upon the adequate growth of the tree, the strength which the two varieties will maintain in making a fine tree. That is something which can be experimented with.

W. J. Krome: I think I might partially answer Mr. Barney's inquiry about the propagation of two or more varieties on a single stock. I have tried that a good many times, generally just two and sometimes as he has done—three and four. I have never found that it was a wise thing to do. The stronger variety will almost every time dwarf the weaker variety, and you will wind up with only one variety on that stock; sometimes the weaker will persist for quite a length of time, but eventually you will come back and have only one avocado of good bearing value on that stock. The second variety during the time it persists might be worth while, simply as a pollina-

tor for your other variety, but you could hardly expect it would be worth while as a producer of fruit.

Mr. Barney: The placing of more than one graft on a single tree was to act as a saver of space. I can put grafts on one tree and save a whole lot of space in the planting; it seems that two different kinds that blended harmoniously ought to be made to grow.

Mr. Krome: If you could get two, one of them in what Dr. Stout and Mr. Savage called Class A and the other in Class B, and have them growing on one stock or stem, and they were of equally vigorous strength, you might have a desirable combination. That has been suggested and is being applied to considerable extent in California, but I begun trying that ten years ago myself, and out of probably 75 or 80 instances of that kind I think I have only 2 or 3 trees remaining where they are still different varieties on the same stock, and even in those cases one of them bears practically no fruit.

Growing Figs in Florida

Harold Mowry, Gainesville

The production of figs is at present of minor commercial importance in Florida. Data furnished by the Department of Agriculture at Tallahassee show total plantings of some 20,000 bearing trees of which about 75% are in the northern part of the state. Practically the whole of these plantings is made up of what might be termed door-yard plantings, there being no commercial orchards of importance. Figures furnished by the State Marketing Bureau give an annual production of about 25,000 crates which have an approximate valuation of $70,000. These are sold in local markets, canned, or preserved. Owing to their perishable nature no fresh figs are shipped except for short distances. Some attempts have been made to place them in northern markets but evidently with little success as such shipments have not been continued. The canned product, if of good quality, is always in good demand.

Only varieties suitable for marketing while fresh, canning, or preserving, are grown. Little effort has been made to grow the Smyrna type for drying purposes. The time of ripening, which occurs during the summer rainy season, precludes the drying of the fruits successfully by open air methods. It is quite possible that were the fruit produced cheaply in large enough quantities adequate methods of drying would be devised. To grow the Smyrna figs in Florida would necessitate the planting of the Capri fig also, as well as the introduction of the insect necesary to caprification. Until some of the handicaps now existing in field culture are overcome there is little likelihood that success would follow such plantings.

The varieties which compose the major portion of present plantings are among those which were recommended by the American Pomological Society during a meeting of that body held in Florida in 1889. These varieties are:

CELESTE (*Celestial, Sugar.*) Small to medium in size; pale violet to purplish brown in color; pulp firm, rose colored, sweet, good quality; season early, begins ripening latter part of June. Is probably the best for canning purposes.

TURKEY (*Brown Turkey.*) Medium to large in size; coppery brown in color; pulp firm, whitish shading to pink, good quality; season begins about mid-July.

BRUNSWICK. Large to very large in size; bluish-purple to dark-brown in color; pulp soft, white, shading to pink, fair to good quality; season begins mid-July or later.

LEMON. Medium to large in size; yellowish-green in color; pulp soft, white,

sweet, fair to good quality; season begins late June or early July.

ISCHIA (*White Ischia, Green Ischia.*) Medium in size; pale-green or greenish-yellow in color; pulp soft, rosy-red or crimson, sweet, good quality; season begins about August first.

BLACK ISCHIA. Medium in size; bluish-black in color; pulp violet red to crimson, soft, good quality; season begins about mid-July.

Of these, Celeste, Brunswick and Turkey are considered to be the most hardy.

The fig thrives best in a deep, moist soil that is well supplied with humus, such as is found in low, well-drained areas. Hammock soils also are satisfactory. When planted adjacent to buildings, thrifty trees are found on a variety of soil types.

Owing probably to the little success which has attended field plantings, no comprehensive fertilizer tests have been made in this state. There is no doubt that the application of phosphate and potash in varying forms is advisable. Lime would seem to be beneficial as some fine specimens of trees are found growing in shell mounds. Mulching is probably a good practice in that it helps to conserve soil moisture and adds to the humus content, but it is contended that if long continued such mulching will tend to cause the feeding roots to come to the surface of the soil, the tree suffering in consequence during periods of drought. Good trees are found in yards where soil is kept swept clean and is packed quite hard by continued trampling. Any cultivation, other than very shallow, must be avoided owing to the shallow rooting habit of the tree. No interplantings of crops which require deep cultivation or are susceptible to nematode attack should be made.

The fig is hardy throughout Florida, withstanding temperatures of 18 degrees normally to as low as 12 or 14 degrees when completely dormant.

According to Dr. G. F. Weber of the Agricultural Experiment Station, the most important diseases found on the fig tree in Florida are, Rust (*Physopella fici* (Cast.) Arth.), Leaf blight (*Rhizoctonia microsclerotia* Matz), Anthracnose (*Glomerella cingulata* (Stonem) S. & V. S.) and Limb blight (*Corticium salmonicolor* Karst) listed in reference to their importance on the host plant.

The Rust on fig leaves is of a very serious nature inasmuch as it attacks all leaves on the tree causing them to be shed prematurely even before the fruit is mature. This you can readily see cuts down the necessary functions of the plant resulting in very marked reduction in yields and at the same time causing the formation of small sized fruit. This disease is distributed in all portions of the state where the fig is grown and I might say almost without regard to weather conditions or variety and is found very destructive. The disease is not found on the trees at the time the fruit sets but when it once starts spreads rapidly over the whole tree.

Instead of giving the control methods here I will discuss the two following diseases and then give the control methods as all three diseases can be controlled with the same spraying. The last of the diseases listed, however, is not effectively controlled by spraying.

The Leaf blight is evident on the trees very shortly after the leaves have expanded and in fact it is even found before the leaves are fully grown. The fungus causing this disease is almost wholly superficial. It can be detected on the stems of the leaves up which it grows from the branch to the leaf blade in the form of numerous fine, silky threads growing parallel to the leaf petiole. When it reaches the blade of the leaf it spreads out over it discoloring it and eventually killing the whole blade. The leaf is eventually shed. This fungus is found on a large number of the growing tips of the branches and also on the young fruit which is not yet mature. Other than the silky threads it produces small brown tufts which appear on the outside of the bark and very much take the place of spores in spreading the fungus.

The third disease known as Anthracnose is of serious nature both on the leaves and fruit. It produces small brown spots on the leaves the centers of which often fall out and on the fruit causes a soft decay. It is probably more important on the fruit than on the leaves and causes considerable rotting of marketable products.

These three diseases can be controlled by the application of 4-4-50 bordeaux mixture in the form of liquid sprays applied with 150 or 200 pounds pressure. The first spray, which is applied before the buds break open, may be considered as a dormant spray. This spray will kill all spores of the organisms that may be adhering to the branches of the tree from the past season. The second spray should be applied as soon as the first leaves are evident. A third application should be made a week after the second and sprays should be applied to the trees until the fruit is as large as the end of a lead pencil. In making applications after this time there is danger of discoloring the fruit and thus making it unsatisfactory for market. Do not spray after this time until the fruit has been picked, then another application or two of this spray will be very beneficial.

As for the limb blight I would say that this disease is uncommon on well cared for trees. This fungus on limbs that have been killed by it is a pale pink colored growth that completely covers the affected parts. Usually this fungus gets started on a dead twig or through a wound caused by pruning. Consequently the control measures to be practiced would be careful pruning at all times of all dead wood, painting the cut surfaces with carbolineum. Since the trees will be sprayed with bordeaux mixture to control the previously discussed diseases this same spray will be sufficient to check the spread of limb blight.

During the past two seasons these diseases have been controlled on several trees in the Experiment Station Plots with bordeaux sprays according to the schedule already given.

The fruit of the Celeste variety is resistant to Anthracnose.

Nematodes, the cause of root-knot, are present throughout the sandy soils of the State, and are generally conceded to be the most serious handicap to fig growing. Apparently all efforts to overcome this pest by means of various chemicals and mulches have met with little success, as

far as fig planting is concerned. At the Experiment Station, during the past two years, experiments have been made with various species of *Ficus* as a rootstock for figs, in the endeavor to find one on which the fig would grow satisfactorily as well as show a resistance to nematode attack. No originality is claimed for this idea, as experiments have heretofore been made along the same lines. Any rootstock for figs, to be of value, must prove itself adaptable to the soils on which it is planted; form a congenial union with its scion; be easily propagated; and show itself to be immune or resistant to root-knot.

In March of 1923, the Horticultural Department of the Experiment Station received several species of *Ficus* from the Office of Foreign Seed and Plant Introduction of the U. S. Department of Agriculture through the courtesy of Prof. E. L. Lord of the College of Agriculture, who had requested this material with the idea that it might prove of value for fig rootstocks. These, together with some already on hand and others later obtained, from other sources, make a total of 18 species of *Ficus* which have been considered in these tests. Practically all have been discarded because of susceptibility to root-knot, failure to form a union with a fig scion, or a seeming incompatibility between stock and scion which resulted in bud or graft forming a union but with an unsatisfactory growth of scion following.

Two species have shown encouraging results. One is an undetermined *Ficus* species, a native of North Queensland, Australia, introduced by the Office of Seed and Plant Introduction in 1921 and distributed under S. P. I. No. 52406. It is described as being "A large clean tree with fruit of fine delicate sweet flavor and size of a black Smyrna fig, only more rounded and dark crimson when ripe." The other is *Ficus glomerata*, a native of Siam. It also is distributed by the Office of Foreign Seed and Plant Introduction, under S. P. I. No. 52496. The latter one has been in the United States for several years. Both are easily propagated from cuttings which root readily at all times of the year. The *glomerata*, in some instances, has not formed a union with a fig scion as readily as has the No. 52406, nor has it always grown off satisfactorily once a union has been formed. No grafts on the *glomerata* have been made for a length of time sufficient to give any definite or comparative results. Both are evergreen types. When set out in the open they are vigorous growers and have a very attractive foliage. They are susceptible to cold injury, both having had their foliage severely injured by a temperature of 29 degrees accompained by a heavy frost. A temperature of 25 degrees killed them back to the bank. The same plants, sprouting from the ground, made a maximum growth of 9 feet during the next, their second, season. A plant of the No. 52406 has lived through two winters in the open at De Land with little or no cold injury.

On March 28, 1923, a cutting was made from the plant designated as No. 52406. A shield bud from an Ischia fig was inserted in this rooted cutting on August 29th. The plant was kept in the greenhouse during the winter and on April 3,

1924, was planted in the open on a very light sandy soil which had been under cultivation at least 15 years. By June 1st of the same year the tree was setting considerable fruit, the first ripening September 9th—a few days over one year from the date the bud was inserted. Nearly one hundred fruits ripened during this first season.. At the end of the growing season the tree had an extreme height of 4½ feet with an extreme spread of 5 feet and calipered 2½ inches just above the bud union. Despite it having been budded on an evergreen root-stock the scion went into a dormant state at the same time as adjacent fig trees on their own roots. Fertilizers were used but no mulching whatever was put about the tree. Cultivation consisted in flat hoeing only. No buildings are adjacent to the tree. Close examination of roots has shown a very slight root-knot infestation.

As a check, a vigorous, clean one-year fig on its own roots was planted on March 4, 1924, at a distance of some 17 feet from where the budded tree was later planted. The two trees were given identical treatment as to cultivation and fertilization. The check tree attained a maximum height of 2½ feet and ripened but one fruit during the season. Examination of roots has shown a heavy root-knot infestation.

To prevent injury by cold, the budded tree was banked with soil during the winter for some three months in the same manner as citrus buds are protected. This banking has proven to be a most serious mistake as, when banks were removed late in February, the bark of the scion under the bank were found completely girdled which necessitated the removal of the whole top of the tree slightly above the bud union. New growth had started on the portion of the scion which was left. No damage could be noted to portions of the tree which were above the bank, showing that the banking and not cold injury caused the damage. This seemingly has demonstrated that this tree when so grafted cannot be banked with a large bank for long periods of time. Owing to the susceptibility of the stock to cold injury it is probable that it cannot be used in Northern Florida. Small grafted trees, however, lived through the past winter in the open in Alachua and Duval Counties without injury by cold.

In propagating this stock. both budding and grafting have been used. Grafting has given the better results. Raffia is used to wrap, after which the whole is covered with melted paraffin to exclude air and water from the union.

The foregoing remarks are in no wise to be construed as being a recommendation of these rootstocks by the Experiment Station. Sufficient time has not elapsed to thoroughly test them out nor have plantings of size been made in varied localities which would prove their adaptablity.

Member: Did the time of year of making the cut or making the graft have any effect?

Mr. Mowry: I have done it all times of the year, but had best success in grafting during January and February

Member: How about the cuttings?

Mr. Mowry: Any month in the year.

Member: Where can they be obtained?

Mr. Mowry: Through the Department of Agriculture, Office of Foreign Seed and Plant Introduction, Washington, D. C.

Member: How much work have you done with the Cluster Fig — Ficus Glomerata?

Mr. Mowry: It has been rather exotic. In some instances it has grown well; in others it has grown and then stopped. The work is in a highly experimental stage as yet. It is well worth giving more time to.

Member: I would like to ask if you have ever tried shipping figs in refrigerator boxes, similar to the strawberries. From your remarks, you couldn't ship them very well. Have any experiments been made along that line so as to get them to a market?

Mr. Mowry: I have no knowledge of any having been shipped in refrigerator boxes. There have been various methods devised for shipment, but none have proved successful for moving any large quantities.

Member: What effect would the moisture in refrigerator boxes have on the fruit?

Mr. Mowry: I can't say.

Mr. Whidden: It appears we can't raise figs on account of root-knot. Can you take an old tree and kill out that root-knot, so it will become perfect?

Mr. Mowry: No, sir. It is too late after you have let the root-knot start. I have never known it to be killed out on any tree after the tree was once affected with it.

Mr. Whidden: About 35 years ago I got very much interested in figs. I sent to Washington. The Department sent me thirteen beautiful cuttings, and I rooted every one of them. I cared for them nicely in my back yard in Bartow, and I think I grew the most magnificent trees I ever saw. I pruned them just as I would a nice orange tree, on a single stock. I mulched them around and didn't work the ground at all. I gave some to my neighbors, two or three, and that left me eleven trees, and I had figs by the barrel, as fine as you ever saw in your life, and Mr. Mowry named the three varieties there tonight that I tried out then. I sold the place. Several years afterwards the trees were neglected, and went to the bad. Twelve years ago I got interested in figs again. I went to the country where I knew there were some nice trees, where they had been growing over twenty years, cut me some little limbs about 8 inches long, brought them home, packed them in Spanish Moss in January, and kept them until about the first of March. Then I selected a place where root-knot was not prevalent, and planted them. I transplanted them in an orchard in the back yard. I didn't work the ground; I mulched them, and produced more figs than the whole community could use. They were there when I sold that place. I haven't seen them in three years, but I had no trouble raising all the figs I and all the neighbors could use.

The Maturity of Citrus Fruits from a Legal Point of View

R. W. Ruprecht

At the time this paper was prepared I did not know that a new law had already been prepared for presentation to the legislature. I will give my paper as prepared and then comment on the proposed law, which has just been read to you by the president.

The analyses reported in this paper were not primarily made to determine the changes taking place during the ripening of grapefruit. They were made to determine the effect of various fertilizers on the sugar and acid content of grapefruit.

The fruit came from our young grove at Lake Alfred and was shipped to Gainesville for analysis at approximately seven to ten day intervals from October 27 to December 16, 1924. The fruit from each plot was picked from the same tree each time, which eliminates variations due to different trees. The analyses were made on the expressed juice from six to twelve grapefruit. In most instances only six were used. While I realize that this is a rather small number, it was the best we could do with the funds we had available.

The fruits were weighed as soon as received, which was generally from two to three days after they were picked. They were then cut in halves and the juice extracted with a porcelain press. The same man operated the press for all of the squeezings and tried to exert the same pressure each time. It is, however, impossible to control the pressure exerted accurately with the press we had. After extraction, the juice was strained through cheesecloth and the Brix reading taken. The acidity was determined by weighing ten grams of the juice and titrating with tenth normal sodium hydroxide, using phenolpthalein as indicator.

At the same time, samples were also prepared for sucrose determinations by the polariscope. The total sugars were determined from the polariscopic readings, assuming that invert sugar was the only other sugar besides sucrose present in the solution.

Samples from ten different trees were taken each time, five Silver Cluster and five Marsh Seedless. The results with all of the samples were similar so that, in making up the table, I used only three of the samples in order to save space.

Glancing at the table as a whole, you will notice that no striking differences exist. A closer study of each determination, however, shows some differences. In the first column, "Weight of Fruit," you will notice that there seems to be

a gradual increase from the first to the last picking. In the next column, the juice content also seems to be gradually getting higher. Toward the end all had over 50%. The Brix readings showed the same trend as the other two determinations, a gradual increase. The sugar or sucrose column does not show any steady increase except in plot 2. The total sugars, however, do show an increase as the season progressed. Just why the sucrose content did not keep pace with the total sugars is hard to explain, unless it was due to some of the sucrose being inverted before we analyzed them. This could easily be the case, as the time that the oranges were on the road varied considerably.

Coming now to the acidity column, we find very little change in the percentage during the six weeks the tests were made. The last column gives the ratio of acid to solids. Here we find a gradual change from a ratio of less than 1 to 7 to one above that figure or, in other words, a change from unripe to ripe fruit in the eyes of the law.

What changes, then, have taken place to change these fruits from green to ripe fruit? So far as our analyses show, the changes have been as follows: an increase in juice content to 50% or better, an increase in total solids as indicated by the Brix reading, and an increase in the total sugars. These changes, for the most part, have been very small, however, and a slight error in either the reading of the hydrometer or in the titration of the juice would change the ratio sufficiently to change the classification of the fruit.

Just a word in regard to the eating quality of these fruits. I ate samples from each lot and, to me at least, they did not improve in taste enough to be called ripe or mature, even when the ratio passed the 1-7 point. There seems to be a general dissatisfaction with the present ratio of one part acid to seven solids for grapefruit. Some claim that their grapefruit never passes the test but is of good eating quality. Others claim that the ratio is too low and that no grapefruit is fit to eat at the 1-7 point. The main trouble is due, I believe, to the fact that the test is based on the content of solids while the eating test is based largely on the sugar content of the fruit. The solids test, of course, measures in a rough way the sugar content but it is quite possible for a grapefruit to contain enough solids, yet be low in sugar content.

I have no suggestions to make in regard to changing the law, as I have not studied the question sufficiently. I believe the thing to do is to start investigational work to see how the law can be changed to give a fairer test. This investigation should be carried out by chemists and not by packing house managers.

We must bear in mind that any changes that are proposed must be of such nature that the tests can be applied in the field, or at least, outside of a chemical laboratory.

In regard to the proposed law, I cannot say that I am in favor of it for the following reasons:

In the first place, I do not think it is enough better than the present one to make it worth while trying to change it. Secondly, it is entirely possible that next

year or the year after a majority of the grapefruit would not pass the new tests but would pass the present test, as was the case in the example cited by Mr. Walker. While it may be true that there has been a change in the composition of the fruit in the last ten years, I believe the change is more likely to be a seasonal one, due to different conditions of temperature and rainfall.

Lastly, while I am not a lawyer, I do not believe that you could enforce the new law on interstate shipments unless the Federal rulings were changed to conform with the new law. Even if this new law is enforcible on interstate shipments, it would pass grapefruit which, according to the Federal rulings, is unripe and would therefore be liable to seizure by the Federal Pure Food authorities.

I believe it would be better to leave the present law as it is, but enforce it and make a thorough study of this whole problem for the next two years, and then go before the Legislature with something that we know will be better.

ANALYSIS OF GRAPEFRUIT

Plot I — Sulphate of Ammonia

Date	Av. Weight	% Juice	Brix	Sucrose	Total Sugar	Acidity	Ratio Acids to Solids
11/ 3	437.6	49.9	8.9	2.64	6.41	1.41	1-6.2
11/ 8	410.0	45.7	8.9	2.78	6.37	1.21	1-7.4
11/17	421.3	51.7	9.3	2.76	6.73	1.33	1-6.9
11/22	557.5	51.8	8.8	2.80	6.89	1.29	1-6.9
12/6	441.3	50.3	9.4	2.54	6.41	1.37	1-6.9
12/16	383.8	50.0	9.7	2.63	7.38	1.25	1-7.8
Plot II — Nitrate of Soda							
10/27	407.5	47.9	8.7	2.90	6.55	1.34	1-6.5
11/3	442.5	49.9	8.3	2.80	6.23	1.33	1-6.2
11/8	440.0	48.6	8.5	2.90	6.39	1.21	1-7.0
11/17	445.8	51.7	8.8	2.88	6.38	1.27	1-7.0
11/22	555.0	51.2	8.5	3.05	6.85	1.26	1-6.8
12/6	469.1	50.6	9.2	3.01	7.03	1.30	1-7.0
12/16	472.8	51.2	9.6	3.05	7.37	1.32	1-7.3
Plot III — Dried Blood							
10/27	368.6	47.5	9.0	2.84	6.89	1.41	1-6.4
11/3	357.9	49.1	9.0	2.73	6.73	1.36	1-6.6
11/8	355.0	51.9	8.6	2.71	6.73	1.31	1-6.5
11/17	400.4	50.7	9.1	2.70	6.82	1.33	1-6.8
12/6	397.9	51.7	9.3	2.59	6.91	1.33	1-7.0
12/16	401.4	51.8	9.4	2.66	7.41	1.31	1-7.2
11/22	448.6	51.5	8.9	2.93	7.42	1.29	1-6.9

Maturity of Citrus Fruits from a Legal Point of View

Seth S. Walker

For many years the growers of citrus fruits have been confronted with the serious problem caused by shipment, early in the season, of immature, inedible fruit. There is no need of dwelling on the evils of this practice and the disastrous effect which it has on the market for good fruit. Most of you are already acquainted with these things through bitter experience.

The obvious remedy is to be found in legislation which will prohibit the shipment of immature fruit, but one of the most difficult features of such legislation is the question of what constitutes maturity. How shall we determine whether or not a fruit is "mature?"

According to Webster's dictionary, a thing is mature when it is "brought by natural processes to completeness of growth and development;" or "fitted by growth and development for any function, action or state appropriate to its kind."

This definition gives us little comfort or help in the problem under consideration, for who is wise enough to say when an orange or grapefruit has reached "completeness of growth and development?" Is it just at that stage when the seeds begin to sprout and the fruit begins to dry? Is it when the corky abscission layer begins to form between the fruit and the stem, causing the fruit to drop? This might be considered "maturity" from the botanical view-point, but such standards as these, would be unthinkable for practical use in controlling the shipment of our crops.

It seems to me that in this connection we might better discard the word "maturity" and substitute the word"edible" or palatable". For, after all, citrus fruits are raised and sold for the sole purpose of being eaten, and consequently the object of the law should be to insure the shipment of only such fruit as can be eaten with enjoyment and satisfaction.

Some one — maybe several of you — will immediately rise and say, "I told you so. We don't need a law. The only thing needed is for each grower to taste his fruit before he ships it." We have frequently heard this recommendation made in perfect seriousness and good faith. In fact it was made by one of the speakers at last year's meeting of our Society. No fair minded person will deny that this would be the ideal method if every one were honest and had good judgment, and did not allow his judgment unconsciouly to be influenced by alluring reports of high prices being paid for early fruits. But somehow or other

a man's sense of taste seems to vary with the market reports, and there will always be a few shippers who are deliberately dishonest. We might just as well say that traffic laws should not include specific regulations — that dangerous driving should be prohibited, but each driver should be left to determine for himself what is "dangerous."

Any regulative law, to be effective, must have definite standards by which the regulations may be carried out and upon which court proceedings may be based in case of violations. The more "cut-and-dried" these standards can be made— the more the personal element can be eliminated from them — the better they are. Physical and chemical measurements are the most definite and satisfactory standards where ever it is practicable to apply them.

What sort of standards, then, may we apply to citrus fruits in order to judge their fitness for shipment? How can we make sure by definite tests that a fruit is good to eat? Certainly not by the color test, that unfortunate joker which still exists in our present state law! Not only is it impossible to make accurate statements regarding the degree of color exhibited by a given sample of fruit but, as has been frequently demonstrated, the color is not a reliable index of the edibility or maturity of the fruit. No, let us forget about the color and give our attention to those constituents on which the flavor and food-value of the fruit really depend, namely the sugar, acid, and other solids dissolved in the juice.

The first attempt in Florida to set a chemical standard for judging fruit was made by a commission of prominent horticulturalists and chemists appointed for the purpose in 1912. They agreed and recommended that an orange should have at least seven parts of sugar to one part of acid in the juice before it is considered fit to ship. However, recognizing that the test should be one capable of being applied in the field or packing-house, and that a sugar analysis could not readily be made except in a chemical laboratory, they suggested that a field test should be made for acid only, and that all oranges having less than 1.25% acid should be passed.

As time went on and more data was accumulated it became increasingly evident that the *ratio* of sugar to acid was a much more proper test than a mere maximum acid test. Then some one conceived the bright idea that, although it was not practicable to determine *sugar* in making routine field tests, a similar result could be accomplished by determining the *total solids* which consist largely of sugar and acid. This total solids test is readily made by means of the Brix hydrometer. The ratio of total solids to acid would of course be higher than the ratio of sugar alone to acid. All of the data available at that time indicated that proper ratios of total solids to acid would be 8: 1for oranges and 7: 1 for grapefruit, and these ratios have been the basis for judging citrus fruits during the past ten years or more, although there has been some conflict with the Florida State law which still includes a color test and a maximum acid test instead of a ratio. These ratios of 8 :1 and 7 :1 were

finally given definite recognition and adopted as standards by the Federal government in September, 1921, as announced in Food Inspection Decision No. 182.

The ratio standards have been a great improvement over the old color test and maximum acid test. In fact, so far as I know, the 8 :1 standard for oranges has given full satisfaction. But with grapefruit the case is different. Many complaints have arisen to the effect that the 7 : 1 ratio for grapefruit works gross injustice during the early shipping season and is not at all reliable as a means of distinguishing between good fruit and poor fruit. It has frequently been found that grapefruit which is obviously immature—dry, juiceless and insipid—will pass the test; while on the other hand fruit that has much better eating qualities because it is heavy with juice and full-flavored, although perhaps more or less sour, will fail to pass.

It may seem some what inconsistent to say that a simple ratio test is satisfactory for oranges and unsatisfactory for grapefruit, but when we study the subject we find that there is real reason for such a difference. If we study the composition of Florida oranges taken from the same trees at intervals during the season it will be found that there is practically always a steady increase of sugar and total solids, and a steady decrease of acid. Consequently the *ratio* of *total* solids to acid will rise steadily — in fact as a rule the ratio curve rises much more rapidly than the total solids curve. It is plainly evident that with oranges the ratio is a fair measure of maturity. But when we make a similar study of grapefruit we find no such regularity of increase. Although there is a general tendency toward increase of total solids with the advancing season, there is frequently an increase in acid content so that the ratio remains practically constant or even decreases. Therefore it would seem that with grapefruit the simple ratio test cannot be taken as a measure of maturity, still less of edibility.

Those who have been studying this question have been impressed repeatedly with the fact that the early grapefruit which is good to eat is nearly always the fruit which has a high per cent of solids in the juice, and that the higher the solids, the lower the ratio of solids to acid may be without making the fruit inedible. This observation has been made so often that gradually a "sliding scale" of total solids and ratio has been evolved which seems to fit the known facts much more closely than does the flat ratio of 7 ;1. This sliding scale is said to have been first proposed by one of the government chemists, after a thorough study of the subject and is as follows:

If solids are less than 9.0% the ratio must be at least 7 : 1.
If solids are 9.0% or over the ratio may be as low as 6.5 : 1.
If solids are 10.0% or over the ratio may be as low as 6.0 : 1.
If solids are 11.0% or over the ratio may be as low as 5.5 : 1.
If solids are 12.0% or over the ratio may be as low as 5.0 : 1.

During the early shipping season last Fall the dissatisfaction with the 7 : 1 standard, as well as other features of the present shipping regulations, became so acute that the Fruitman's Club, repre-

senting a large proportion of the citrus growers of the state, appointed a committee to investigate the matter and prepare a new law to be presented to the 1925 legislature. Since the committe was composed of non-technical men they called into consultation a sub-committee composed of the State Commissioner of Agriculture, the Chief Chemist of the Savannah Station of the U. S. Bureau of Chemistry, and the Chemist of the Florida Citrus Exchange, and placed upon this technical committee the task of revising citrus fruit standards.

After a thorough study of the available data on Florida grapefruit, involving 1500 to 2000 separate analyses, this technical committee has been forced to the conclusion that we still lack the necessary information on which to base a perfectly satisfactory standard for grapefruit, but is unanimously of the opinion that the sliding scale mentioned above is a big improvement over the present standard of 7 : 1. And they are of the opinion that the sliding scale can be still further improved by incorporating in it a minimum requirement of 8.5% total solids. That is to say, this modified sliding scale will not permit any grapefruit to pass, whatever its ratio may be, unless the juice contains at least 8.5% total solids. It is believed that this requirement will not work any hardship on the legitimate shipper of early fruit, but that it will be an effective means of preventing the shipment of dry juiceless fruit which otherwise might get by on account of having low acidity and consequently a high ratio.

It has already been stated that hundreds of analyses were examined before arriving at the conclusions set forth above. I shall not burden you with details of these figures but wish to call attention to the summary of them. Out of 1385 samples of grapefruit analysed in the early shipping season (most of them in October) 45% of all samples passed the 7 : 1 standard and 57% passed the proposed sliding scale. Contrasted with this we have 134 samples analyzed in February and March (when the fruit is certainly mature if it is ever going to be) and of these only 59% passed the 7 : 1 test while 83% passed the proposed sliding scale. Thus it will be seen that neither one of these standards is an infallible index to maturity, but that the sliding scale fits much better than does the flat ratio.

An interesting side-light is obtained on this subject if we compare the figures just given with similar figures collected twelve years ago. During the season of 1912-13 the State Experiment station analyzed a considerable number of grapefruit samples, beginning with the early Fall and following right on through the season. When these analyses are grouped into two periods—early and late—and tabulated it is found that of the early samples 83% pass the 7 : 1 standard and 62% pass the proposed sliding scale; of the late samples 95% pass the 7 : 1 standard while only 80% pass the proposed sliding scale. In other words, for those samples, taken twelve years ago, the 7 : 1 standard appears to have indicated maturity more accurately than did the sliding scale. Although I am not drawing any definite conclusions from this comparison, it suggests the interesting possibility that the average composition of

our grapefruit has changed during the past twelve years and that the 7 : 1 ratio which was evolved to fit former conditions no longer is adequate.

Summing up: The standards used for judging citrus fruits are of necessity based on the edibility of the fruit rather than any exact measure of "maturity" since we do not know what constitutes maturity. Definite standards are needed and the most satisfactory ones known at present are those based on the acid and total solids content of the juice. Originally a maximum acid standard was tried but this was soon supplanted by a ratio of total solids to acid. The accumulated data and experience of recent years have indicated that the flat standard of 8 : 1 is satisfactory for oranges but that a flat standard for grapefruit is very unsatisfactory, due to the fact that the edibility of grapefruit depends as much on its juiciness and the total solids content of its juice as upon the ratio. A sliding scale of total solids and ratio has been found to fit the known facts much better than the flat ratio of 7 : 1 now in use for grapefruit.

In conclusion, it may not be out of place to say that the modified sliding scale described in this paper has been unanimously agreed upon by the Fruitman's Club and has been incorporated in a new law which the club is endorsing and hopes to have passed by the present legislature.

Member: If you are not in favor of the law, then would you suggest leaving things as they are?

Mr. Ruprecht: Yes; I haven't any remedy.

Member: We are going from bad to worse. We have got to have a remedy.

Member: Mr. President — I have a remedy. Don't let any grapefruit be shipped until Dec. 10th, and then let it pass some reasonable test.

Mr. Edwards: I have made tests starting in November, up until the latter part of February. I have found that our highest test was in January,— that it had fallen in February; in January the highest we got was 6 to 1, with a 10% solid; in February it dropped back 5 to 1, with a 5% solid, so your shipping it Dec. 10th is off. Your sliding scale seems to be the best.

Mr. Chase: The present Federal Law of seven to one on grapefruit was established when Mr. Carl Alsburg was chief of the Pure Food and Drug Division of the U. S. D. A. His attention was called to the fact that grapefruit were very slow in reaching the standard of seven to one. He sent a chemist to the State who carried on and made tests during several winters. I saw him in his Washington office, after he had had those reports, and he told me at the time that he was satisfied with the maturity test on oranges, but he was not satisfied with the grapefruit at seven to one. Unfortunately, he left the employ of the Government, and I feel quite sure he would have made some change in the law, or ruling, on grapefruit.

I think Mr. Walker's article was a very fair article, because the harm to the reputation of Florida grapefruit is brought

about by woody grapefruit, which is shipped, and which very often passes the present test. When grapefruit has an excess quantity of acid it must be overcome by use of sugar. The grapefruit industry is too extensive now to confine itself to any fixed period for shipment. It also grows and matures differently in various parts of the State, so we couldn't fix any law, for December, or any other month that would be fair. What we want is a fair law, and if this present proposed law is a fair law, and excludes the shipment of woody grapefruit, it should be considered very carefully, and Florida should get in behind it. I think the Federal Government, if the matter is taken up now, with the proper people, will bring about the proper ruling covering inter-state shipments.

Mr. Walker: I would like to state that the sliding scale is simply the result of the work that Mr. Chase just referred to, namely the Government chemist did down here. All that the Fruitmen's Committee did was simply to take that scale and build it to the known figure that we had. We simply applied it to the situation. It meets the need much better than the other. We are frank to say that we don't know anything about this situation. It's something that needs a great deal of investigation.

Mr. L. B. Skinner: In your opinion, this is very much better than the present situation?

Mr. Walker: It certainly is. Dr. Ruprecht mentioned the possibilities that seasonal changes would have a lot to do with it. One year seven to one would be better and the next not, but these figures I gave you cover the past 4 or 5 years. An average was taken.

Mr. Barney: I am from Manatee County — the hotbed of all this trouble. In Manatee County the editors of newspapers contend we have been carrying on this damnable business of shipping green fruit. It isn't altogether so, but we have a peculiar situation. We have been making tests of grapefruit all last season, all this season, and up to the present time, and while at our packing houses early in the season, we found some samples of grapefruit that would meet this 7 to 1 test, not once since then has any of our grapefruit come up to this test, and right to-day we are shipping grapefruit that I am sure anyone in this business would deny being absolutely mature and ripe. It doesn't come anywhere near that test. It may be white sand, or it may be something else, but that's the condition there. We want to ship that grapefruit, and I ask the privilege extended to Manatee County to offer the resolution for the endorsement of this Horticultural Society for the passage of that law,—Manatee County being, so-called, the chief-sinner, —if Mr. Walker will say that that law can be enforced. We want a law that can be enforced; we will live up to it, and we want the other fellow to do it. I believe that the law that has been proposed by the Fruitmen's Club is the latest thing in laws on that subject, but according to Mr. Walker I believe he admits there is still something to be found out about that grapefruit situation. If that law is to be endorsed I ask the privilege to offer the resolution to the effect that Manatee backs it up, and will stand by it.

Mr. Voorhees: I would like to ask if there is any understanding, officially or unofficially, that if this law is passed by the Florida Legislature, it will be adopted by the National Government? Suppose this proposed law is passed by the Florida Legislature; as a consequence the present law will necessarily be repealed; then if this law is not adopted by the National Government — what would be the situation?

Mr. Skinner: I think the standard of 7 to 1 is not a law of the National Government, but is a ruling of the Food Department of the U. S. D. A.

Member: That is law within the law.

Mr. Skinner: It is law under the law, but it is more easily changed than to have an Act of Congress to change. As Mr. Walker says, this is based upon the work, and also is the conclusion of the National Food Authorities and I venture to say that they probably are waiting for us to take the first step; at least, that's the way it strikes me. I don't know how it strikes the rest.

Member: May I ask, Mr. Chairman, if that's the case, what is to prevent the Food Division of the Department of Agriculture from adopting this proposed law immediately, and if so adopted, what more is really necessary?

Mr. Skinner: The Agricultural Department hasn't the authority.

Member: I mean the Food Division of the U. S. Department of Agriculture.

Mr. Skinner: We have got to enforce it. The National Government doesn't pretend to stop the shipment under the present law, unless it has been colored. You can ship all the green fruit you want to if you don't conceal the fact of artificial coloring.

Member: May I ask if this law is adopted by the State Legislature, and becomes a law of the State, is fruit shipped in interstate commerce not subject to this law, and does it not then come back to the proposition that to make this thing effective it must be adopted by the Food Division of the National Government?

Mr. Walker: The question has just been asked me whether this has been taken up by lawyers or chemists. It most certainly has by lawyers. At Gainesville and Tallahassee, a very prominent attorney got up this bill, and I believe Judge Andrews put on the finishing touches. It was brought out very definitely in the Fruitmen's Club that there would be no such trouble, viz: that the railroads could accept all the fruit they wanted. These lawyers were not of that opinion at all. They seemed to think that the railroads could not accept the fruit unless under this certificate.

Mr. Ruprecht: Miss Rose might give us some information on that.

Mr. Skinner: I think the point is that it is not interstate traffic until after it is accepted by the railroad; that the penalty here is for offering for shipment, before it is an interstate shipment, and I think it is within the province of the State to protect itself in that respect.

Member: I am no lawyer, and I don't want to get into legal discussion, but I don't see how locally, within the State, you can prohibit or penalize a citizen for offering that which is approved for interstate traffic.

Miss Muriel Rose: I believe that the

National Government has a ruling whereby if a State has a certain law, that that State law holds, in preference to the National law. I believe that is the ruling under several cases which have been tried. There was one, I believe in Wisconsin, in a butter deal, in which the State has a different standard from the National. It was ruled that the State standard holds. The proposed sliding scale, the Government, I believe, will consider it as a tolerance, not as a law, or anything like that, but if we have it in form, then the Government would consider this as a tolerance.

Mr. Stewart: I understand that any commodity to be shipped out of the State is interstate commerce, and you have a right to offer it. I had a question sometime ago — in which we pay more for expressage on a half box or a box of oranges here in Florida, to any part of Florida, than if we sent it to Alabama, Georgia or North Carolina, and I called the Railroad Commission's attention to it. They said they were going to regulate it. I don't like to have to pay more for an express package to Jacksonville than I do to Atlanta, Ga., because it was a State shipment. If it went to Georgia it was then interstate, and the express companies didn't dare approach upon the National Government by charging us as they should.

Member: Is it intimated that the State cannot penalize its own citizens? We have certain State rights and National rights, but I think we have a right to send our fruit wherever we want to if the National Government permits us to do it.

Member: I understand the National Government has offered to send inspectors here to inspect the fruit, and give a certificate of inspection by the National Government. I get that information from the Citrus Exchange. We have heard a good deal said about green fruit. I have been observing the proposition, and the Exchange and others have been talking about this coloring process. I go all over the State. Wherever I go I find there is a coloring process. Every fruit that is raised in Florida, when it reaches its maturity, has its natural coloring. I don't believe this can be settled until the fruit shall be picked in the grove with the natural color, and I believe then the fruit will be matured, and it will be a better color.

Member: You wouldn't ship any Parson Browns out of this State then.

Mr. Warner: Would it be proper to move that there seems to be a question before the house, and possibly if you appointed a committee to consult the proper advice,—legal people here, in the town,—it might clarify the situation.

Mr. Skinner: There may be some representative of the Fruitmen's Club here; unquestionably that question has been thoroughly considered. The Fruitmen's Club was composed of L. C. Edwards, president of the Citrus Exchange, W. H. Mouser, and Mr. Newton, of the Standard Growers' Exchange, Mr. Skelly, of the American Fruit Growers, and Mr. Kilgore, of Clearwater. I know these gentlemen well enough to know that they would not proceed with a law of this kind without being sure of their legal ground, and, in fact, a message was sent to me by

Judge Andrews, in which he said that this law was all right, and they ought not to change a word of it, because it might make it a loop hole for somebody to crawl through it; that if it was endorsed it should be endorsed as it is, because now it is legal. If you change it, it may not be legal, and it seems to me we are up against a situation that demands some action. The Legislature is now in session and we should not delay this matter. This bill will be presented, and it may be a solution of our troubles. At any rate, it strikes me that we could not be any worse off than we are at present.

Mr. Williams: We are certainly confronted here with a situation that ought to be acted on in my opinion. The present law is of no value to this industry, and I think it is an injury. I think the Legislature and the people of the State are looking to this organization to take some action, and make a recommendation on this vital question. Therefore, according to my idea, it would be a mistake for us to attempt to delay the matter. I think some definite action should be taken. The law as proposed here has been gone into by representatives who have been appointed for that purpose, and I feel certain they have gone into the matter very carefully. No better recommendation is before us than this. The fate of the whole industry, so far as grapefruit is concerned, and in my opinion so far as oranges are concerned, from a profit standpoint, is at stake. If we leave here to-day without taking definite action against the shipment of green fruit, and put it in some form that is definite, I think we will be making a very great mistake and injuring ourselves. So far as the point between the State and Federal Government is concerned, I was in the practice of law for a great many years in New York. I do know that the State has a perfect right to pass its own laws, and penalize its citizens for infringement thereof. So far as the enforcement of Federal Government is concerned, we cannot look to them for it; it's got to be done by ourselves — by taxation, assessment, or some other way. There is no question but what we have a perfect right to pass this law, and to penalize anyone who infringes on it. The Government will not step into this question, except where the coloring enters into it. The food regulations are such that they don't attempt to do it. It seems to me it is up to us to take definite action. Personally I am favorable to this law, because nothing better has been presented.

Mr. Skinner: There is an endorsement on this bill, endorsed by the Fruitmen's Club of Florida, composed of the Citrus Exchange, and independents, whose members compose 80% of Florida's citrus growers.

Member: Just a word in explanation. The Florida Fruitmen's Club will support anything which tightens up the law, and enforcements regarding grapefruit shipment, but not to let go of anything that we have got, until we are sure we are getting hold of something better. I would like to see the law made much more stringent than is proposed to be made by this proposal. I will support that proposed law, provided we are not going to get into worse trouble than we are in already.

Mr. Whidden: Since the agitation has been up for the last year as to this green fruit law proposed, I have been in close touch and consultation with some of the most prominent men of the Florida Fruit Exchange. I know that they have studied this question thoroughly, to the limit, with good legal talent and good business judgment. I think that their deliberation has arrived at the right conclusion. I am thoroughly in favor of it, and I hope this Convention will endorse it unanimously.

Mr. W. J. Krome: I am very much indebted to Mr. Barney for his statement that Manatee County is a hotbed of green citrus fruit shippers. For a good many years I had labored under the impression that Dade County got the credit of shipping 99% of the green fruit. I have been shipping grapefruit from Florida for nearly 20 years, and I believe that the present 7 to 1 test went into effect about 1912; I may be a year off. I began my testing at least about that time. Since that time I have run anywhere from 100 to 400 or 500 tests on grapefruit and oranges every season. On at least two other occasions when this matter came before this Society I have expressed the opinion that the 7 to 1 test for grapefruit particularly, and to some extent the 8 to 1 ratio for oranges, did not represent the maturity of those fruits, and that it was not entirely satisfactory as to edibility, but I have results of my tests; I have gone back over my data, and I have failed to find a sufficient regularity, or any other factor that enters into the test to make me at all certain that it would form a basis for a standard test of even edibility for more than the season in which it was taken. I will admit that the 7 to 1 ratio for grapefruit fluctuates a great deal. It fluctuates not only seasonally, but it fluctuates in a season without affecting the edibility of that fruit. This year I tested my fruit very closely, and when I was satisfied that it was over 7 to 1 I shipped it. Now that fruit I believe was edible; it tested an average of 7.35. At the time I shipped two cars of that fruit there were at least 8 or 10 cars in my grove that would pass that test. Purposely I had the first car of that fruit shipped to Chicago, where it would be inspected, and as nearly as possible sold on its merits,—not a F.O.B. sale. I believe that that car of fruit, up to the last reports that I had, brought the highest price of any car that has gone out of Florida this year. It sold up above $9 a box. I followed that car with a number of other cars of the same branch. Out of the next six cars, 4 cars topped the market on the Chicago auction the day that they were sold, and I don't believe that those four cars were any better on the day that they were sold than several others. I don't claim to raise any better than hundreds of other growers, and I believe that there were a number of other marks that were as good or better than those of mine that were sold on that day. My fruit was probably not any better graded or packed. As a matter of fact, those cars sold on the basis of that first car of fruit. It was the first car of fruit, I believe that was sold on Chicago auction this year. I believe that the people that bought it were satisfied as to its edibility, and bought more of it. That fruit tested 7.35 to 1. None of the

other tested below it. Most of it tested above, but immediately after the first two cars were shipped we had heavy rains, enough so as to stop our picking. Those rains lasted for 4 or 5 days; at the end of that time we were ready to resume picking, and I resumed my test. My ratio had dropped a whole point — from 7.75 to 6.50. We stopped immediately on our shipments. We didn't ship again until we were satisfied it was over, and we waited over two weeks. I believe, myself, that that fruit, after those rains was as edible as it was before. The ratio had changed; the juice contents, however, had not changed, and I don't think that the solids showed much change. It wouldn't pass a 7 to 1 ratio, but I believe it was edible.

I am not very strongly in favor of some other law, some other regulation, but I do not agree with several speakers that the present law is as good as no law at all. I have seen, at least, in Dade County, that the present law holds back green fruit — better this year than I have ever known before. I have seen conditions, where certain sections didn't ship any mature fruit at all, and those of us who did try to abide by the law simply paid the penalty. I agree that we want a law, and we want a stiff law that will keep the immature or inedible fruit off the market. I don't care whether it is mature or not; (there is no standard of maturity), but we can establish a standard of edibility. The fellow at the other end wants it to eat, and unless we can tell exactly when fruit is mature and edible, and we find that they conform, it isn't a standard of maturity we want. It's a standard of edibility. The other man judges our fruit by its edibility.

I think I am as strong as anyone here can be for a better law, when that is enforcible. I think this law is a step in the right direction, but until we have had more than one year's test; until some of the points that have been brought up here to-day are clarified; until we know that this law can be enforced, I am opposed to its adoption or endorsement by this Society. If we adopt this law, or if it is passed and found unconstitutional, our present law is repealed, why then I will admit that until we get something better, we might as well go out of the grapefruit business. Our present law isn't good, but I have always been opposed to swapping the devil for a witch.

Mr. R. P. Burton: This is a question that has been more or less discussed to my knowledge for 15 years. The present law is inadequate, not worthless. It was enforced all the past season — the first time since it has been on the books of Florida — not because of the law itself, but of the man who enforced it. He had to enforce it. He took the field and went out and enforced it, but it is the first time. However, the law is not equal to the situation. There isn't a man here who will not admit that the shipper of immature fruit has not damaged this country, and will continue to damage it. It happened when the law was passed that the Florida Citrus Exchange was the only association that was tryng to uphold the maturity of our fruit. The color test, for instance, made it inadequate. The most illuminating thing to my mind is this,—and the thing I think that we all ought to be grateful for, is this clamoring for a law

that can be enforced. The fact that the Fruitmen's Club, which is composed of the Florida Citrus Exchange, and the independents, recognizes the necessity of a law that can be enforced,—now if you think that law can be enforced, and the United States Pure Food Department will join hands with you, and see that it is enforced, this ought to be sufficient, and I am going to ask the gentleman from Manatee County to make his motion that we endorse that law.

Motion made by Mr. Barney and seconded by Mr. Burton that the proposed law be endorsed by the Florida State Horticultural Society. — Motion unanimously adopted.

A BILL

To Be Entitled

An Act to Prohibit Certain Disposition of Citrus Fruit Which is Immature or otherwise Unfit for Consumption, and to Provide for Enforcement Thereof:

Be It Enacted by the Legislature of the State of Florida:

Section 1. That, as used in this Act, the word "person" shall extend to and include persons, partnerships, associations, and corporations; that the word "box" refers only to the standard size containers now in common use in this State in the packing and shipment of citrus fruit; and the words "citrus fruit" shall extend to and include only the fruits of Citrus grandis *Osbeck*, commonly and hereinafter called grapefruit, or pomelo, and Citrus sinensis Osbeck, commonly and hereinafter called oranges; the words "packing house" shall extend to and include any structure or place prepared for and used for packing or otherwise preparing citrus fruit for market or transportation.

Section 2. It shall be unlawful for any person to sell or offer for sale, transport, prepare, receive, or deliver for transportation or market any citrus fruit between the 31st day of August and the 26th day of November in any year unless such fruit is accompanied by a certificate of inspection and maturity thereof as defined by this Act, issued by a duly authorized Citrus Fruit Inspector, or the State Chemist, or Assistants, or Food Inspector or duly authorized inspector of the United States Bureau of Agricultural Economics.

The certificate of inspection and maturity mentioned in this Act shall be of such number, form, size and character, and shall be used in such manner to identify the fruit to which they relate, as the Commissioner of Agriculture of this State may by rule or regulation prescribe.

Provided, that it shall be unlawful during the remaining period from November 26th to August 31st following in each year, when no inspection by any "Citrus Fruit Inspector" is required by this Act for any person to sell, offer for sale, transport, deliver or prepare for sale or transportation any citrus fruit which, under the pure food laws of this State as already provided, is immature or otherwise unfit for consumption, or for any person to receive any such fruits under a contract

of sale, or for the purpose of sale, offering for sale, transportation, or delivery for transportation thereof.

Provided further, that the provisions of this Act shall not apply to sales of citrus fruit "on the trees," nor to common carriers or their agents when the fruit accepted for transportation or transported by such common carrier is accompanied by a proper certificate of maturity of such fruit, as hereinafter provided.

Section 3. AA. That within the purpose and meaning of this Act, pomelos (grapefruit) shall be deemed to be mature only when the total soluble solids of the juice is not less than 8.5 per cent, and when the ratio of total soluble solids of the juice thereof to the anhydrous citric acid is as follows:

a. When the total soluble solids of the juice is not less than eight and one half (8.5) per cent, the minimum ratio of total soluble solids to anhydrous citric acid shall be seven to one (7 to 1).

b. When the total soluble solids of the juice is not less than nine (9) per cent, the minimum ratio of total soluble solids to anhydrous citric acid shall be six and one half to one (6.5 to 1).

c. When the total soluble solids of the juice is not less than ten (10) per cent, the minimum ratio of total soluble solids to anhydrous citric acid shall be six to one (6 to 1).

d. When the total soluble solids of the juice is not less than eleven (11) per cent, the minimum ratio of total soluble solids to anhydrous citric acid shall be five and one half to one (5.5 to 1).

e. When the total soluble solids of the juice is not less than twelve (12) per cent, the minimum ratio of total soluble solids to anhydrous citric acid shall be five to one (5 to 1); and,

BB. That *oranges* shall be deemed to be mature only when the juice thereof contains not less than eight (8) per centum of total soluble solids to each part of anhydrous citric acid.

In determining the total soluble solids the Brix Hydrometer shall be used, and the reading on the Hydrometer corrected for temperature shall be considered as the per centum of total soluble solids. Anhydrous citric acid to be determined by titration of the juice, using standard alkali and Phenolphthalein as the indicator, the total acidity being calculated as anhydrous citric acid.

CC. Any citrus fruit not conforming to the above standards shall be deemed and held to be immature within the meaning of this Act.

Section 4. The owner, manager or operator of each packing house at which it is intended to pack or prepare citrus fruit for market or transportation during the then present or then next ensuing citrus fruit shipping season, shall register such packing house and its location, shipping point, and post office, with the Commissioner of Agriculture, not less than ten (10) days before packing or otherwise preparing any citrus fruit for sale or transportation in or at such packing house; and he shall in addition to such registration give the said Commissioner not less than seven (7) days written notice of the date on which the packing, or other preparation for sale or transportation between August 31st and November 26th of citrus fruit of the then current or

then next ensuing season's crop would be begun. And it shall be unlawful for any person to operate a citrus fruit packing house or to pack or otherwise prepare for sale or transportation any citrus fruit at such packing house without having previously registered said packing house and given the notice herein required; provided that, no certificate of inspection and maturity of any fruit shall be issued by any authorized Inspector to any person who has not registered with the Commissioner during the then current year or has not given to said Commissioner the notice as required by this Act, nor until after payment of the inspection fee imposed by or under the provisions of this Act and such payment evidenced as herein required or authorized.

Section 5. Every vender or shipper of citrus fruit between the dates August 31st and November 26th of each year shall pay to the Commissioner of Agriculture a fee of one and one half cents for every box of citrus fruit by him, it or them sold, transported or delivered for transportation, or, when such fruit is sold or transported in bulk or in containers other than standard size boxes shall pay one and one half cents for each Two (2) cubic feet or each eighty (80) pounds of such fruit, provided, however, that if the Governor and Commissioner of Agriculture shall determine, not less than thirty (30) days before the first day of September in any year, that a smaller fee than that herein named will produce sufficient funds to defray the expenses of and incident to the enforcement of this Act during the then next ensuing citrus fruit shipping or marketing season, the Governor may by order and proclamation reduce the fee to be paid during such next ensuing season to such sum as may be deemed sufficient for said purpose.

Such fee shall be due when the fruit is prepared for market or transportation, and payment thereof shall be evidenced by stamps as hereinafter provided. And it shall be unlawful to sell, deliver, transport, or deliver or receive for transportation, any citrus fruit payment of the fee for which is not evidenced by proper stamps as may be provided by regulations prescribed by the Commissioner of Agriculture.

Section 6. It shall be the duty of the Commissioner of Agriculture to furnish the venders and shippers of citrus fruits with such stamps to be attached to the packages of fruit prepared for sale, transportation, or delivery for transportation, or to the certificate of inspection and maturity, herein provided for, as the Commissioner of Agriculture may by rule or regulation prescribe.

Section 7. It shall be unlawful for any authorized Inspector to make or deliver a certificate of inspection and maturity of any citrus fruit upon which the inspection fee hereby imposed or authorized has not been paid, or to make or issue any false certificate as to inspection, maturity, or payment of inspection fee.

Section 8. All citrus fruit prepared for sale or transportation, or which is being prepared for such purposes, or which has been or is being delivered for sale or transportation, that may be found to be immature or otherwise unfit for consumption upon inspection and testing,

shall be seized and destroyed by a Citrus Fruit Inspector or the Sheriff of the County where found, as may be provided by regulations prescribed by the Commissioner of Agriculture.

Section 9. Upon recommendation of the Commissioner of Agriculture the Governor may in each year appoint and commission as many Citrus Fruit Inspectors, for such period or periods, not exceeding one year, as said Commissioner shall deem to be necessary for the effective enforcement of this Act. Such Inspectors shall make and file in the office of the Secretary of State the oath required by the Constitution of this State, and shall give a good and sufficient bond in the sum of One Thousand ($1000.00) Dollars for the faithful performance of the duties of such office. Such Inspectors shall be governed by the provisions of this Act and such rules, regulations and provisions as may be prescribed by the Commissioner of Agriculture and shall perform their duties under his direction and supervision. The salary of each Citrus Fruit Inspector shall be at the rate of One Hundred and Fifty dollars ($150.00) per month, and in addition thereto shall receive his or her necessary traveling and other expenses incurred by him or her in discharge of his or her duties as such Inspector, which shall be paid upon approval of accounts therefor by the Commissioner of Agriculture.

The Commissioner is hereby authorized and empowered to employ such additional field and other agents and clerical assistance, at such times and for such periods and to incur and pay any other expenses, including traveling expenses of the Commissioner of Agriculture, during the Citrus fruit season as may be necessary for the effective enforcement of this Act, and to secure the payment of the inspection fees hereby imposed or that may be imposed under the authority of this Act.

In cases of emergency or necessity when no Citrus Fruit Inspector is available for inspection of a particular lot of citrus fruit, the Commissioner may designate some fit and competent individual to inspect, test and certify as to such lot of fruit. Certificates made or issued by such designated individual shall be signed by him or her as "Special Citrus Fruit Inspector;" he or she shall not be required to give any bond, but shall be subject to the penalties imposed by this Act for any violation of any of the provisions hereof.

Section 10. The Commissioner of Agriculture shall, from time to time, as he may deem to be expedient and necessary, make and promulgate rules and regulations for carrying out and enforcing the provisions and regulations of this Act.

Section 11. Any person who shall violate any of the provisions of this Act, or do or commit any act herein declared to be unlawful, or shall violate any reasonable rule or regulation made and promulgated by the Commissioner of Agriculture in pursuance of the authority therefor herein given, shall be punished by a fine of not less than Fifty Dollars ($50.00) and not more than One Thousand Dollars ($1000.00) or by imprisonment for not less than one month and not more than twelve months, or by both such fine and imprisonment in the discretion of the Court.

Section 12. It shall be unlawful for any person to obstruct or resist any authorized Inspector in the performance or discharge of any duty imposed upon or required by him or her by the provisions of this Act or by any rule or regulation prescribed by the Commissioner of Agriculture as herein authorized.

Section 13. All money received by the Commissioner of Agriculture for inspection fees and certificates of inspection and maturity shall be paid by him to the State Treasurer who shall deposit said money to account of "Citrus Fruit Inspection Fund."

All salaries and other expenses incurred in the execution and enforcement of the provisions of this Act shall be paid out of such "Citrus Fruit Inspection Fund" (except as provided in the next succeeding Section) by vouchers approved by Commissioner of Agriculture and warrant issued thereon by the Comptroller.

Section 14. In order to provide for the expenses incident to the enforcement of this Act during the citrus fruit shipping season of 1925 and 1926, the State Comptroller and Commissioner of Agriculture are hereby authorized to transfer to the Citrus Fruit Inspection Fund the sum of Fifty Thousand Dollars ($50,000.00) from other Inspection Tax Funds of this State. Provided, however, that said sum shall be returned to such other Inspection Tax Funds from the proceeds of the inspection fees hereby authorized as soon as practicable.

Section 15. All laws in conflict with the provisions of this Act are hereby repealed.

Section 16. This Act shall take effect immediately upon its becoming a law.

The Borax Treatment of Citrus Fruit for Prevention of Decay

H. R. Fulton, U. S. Bureau of Plant Industry, Washington, D. C.

Practically all of the decay of Florida citrus fruit after leaving the tree is either blue mold rot or stem end rot. The control of these two forms of rot is a factor of prime importance in the successful marketing of the crop of any season. For stem end rot five methods of control have proved more or less effective as follows: (1) Pruning out of dead wood, the breeding ground for the two fungi that produce stem end rot. Pruning is more effective against Diplodia than Phomopsis stem end rot, but on the whole must be rated as probably not more than 50% effective. (2) Spraying the young fruit with bordeaux oil emulsion for melanose control cuts out about half of the stem-end rot in the matured fruit after picking, and is more effective against Phomopsis than against Diplodia. (3) Disbuttoning, properly carried out, is over 95% effective against both forms of stem-end rot, and may be accomplished during the precoloring process by maintaining humidity above 90% with temperature between 80° F. and 90° F. (4) Prompt handling. Both types of stem-end rot are relatively slow in starting on the fruit after picking, and seldom cause appreciable loss in less than ten days or two weeks from the tree unless temperatures are abnormally high. (5) Low temperatures greatly prolong the development period of both types of stem-end rot, and are very effective in the successful marketing of fruit subject to this decay. To a large extent this merely postpones decay, and shifts the burden of loss to the buyer. It will be noted that two of the foregoing control measures, pruning out dead wood and spraying for melanose control, are in the hands of the grower of the fruit; the other three measures, disbuttoning, prompt handling, and subjecting to low temperature, are in the hands of the shipper.

Effective control of blue mold rot in the past has involved three things: (1) careful handling at every stage to prevent the breaks in the skin necessary for blue mold infection. (2) keeping the surface of the fruit as dry as possible, so as not to have continuous moisture long enough for blue mold spores to sprout and grow. (3) temperatures low enough to greatly retard the growth of the blue mold fungus, which means about 45° F., some ten degrees lower than an effective temperature for stem-end rot control.

For a long time fruitless search has been made for a satisfactory chemical agent that will control these rots. For several years the U. S. Bureau of Plant Industry has been investigating blue mold

control by fungicides, following a different line of attack from those previously used. It was found that dipping the citrus fruit in 5% solution of borax (40 pounds borax in 100 gallons water) protects it against blue mold decay to a marked degree. Leaving a certain amount of the borax sediment on the fruit makes the treatment more effective, and subsequent brushing of the surface-dry fruit, as in packing house polishing, does not materially lessen the effectiveness. Increase in temperature of the solution and prolonging the exposure to the warm borax up to the limit of tolerance of the fruit increase the effectiveness very materially. The treatment is highly effective even 24 to 36 hours after the fruit has been subjected to blue mold infection. A very fortunate and entirely unexpected development in the testing of the borax treatment is its very high effectiveness against both types of stem-end rot, after either hot or cold applications.

COLD BORAX TREATMENT

In packing house operations the simplest and least expensive type of installation is for the cold borax treatment. All that is necessary is a small tank with a conveyor, through which the fruit may pass after being washed and scrubbed, and before entering the drier; or else a sprinkling device that will wet the fruit thoroughly with the borax solution after it has been scrubbed and before it is dried. In the latter case, the borax spray is caught in a pan and recirculated by means of a rotary pump. The solution, if kept reasonably clean, may be used for a week or two without renewal. Attention must be given to maintaining its proper strength. In cool weather, if the temperature falls below about 68° F., the saturation point will be lowered to less than 5% for borax, and it will be necessary to use some means of keeping the temperature above 68° F. in order to maintain a full 5% strength. If water brought in on the surface of the fruit from the scrubbers tends to dilute the solution, a slight addition of borax from time to time will be necessary to maintain the proper strength. Concentrations of solution up to 10% do not injure the fruit, but leave a too conspicuous sediment, and are only slightly more effective than 5% solution. With the 5% cold treatment the polishing brushes take off occasional blotches of unsightly sediment, and the fruit has a good appearance after treatment, even though the surface carries an inconspicuous coating of fine borax crystals sufficient to protect against later infection. In extensive laboratory tests on commercially handled fruit of inferior grade, held after treatment at 70° F. with high humidity,—conditions that would give every chance for rot to develop,—it has been found on the average that something over 50% of the blue mold decay and almost 75% of stem-end rot are prevented, over a two to three weeks' marketing period. These degrees of effectiveness have been fully maintained in commercial shipments. The cost is only a fraction of a cent a box. One dollar per car is ample to cover all costs of the cold borax treatment. About 50 packing houses have used it during the past season in Florida.

HOT BORAX TREATMENT

Preliminary laboratory tests have shown increased effectiveness of the borax treatment with progressive rise in temperature when the fruits are allowed to remain for several minutes in the hot solution. For several years in California lemons and to some extent oranges, have been washed for four or five minutes in water at 115 to 120° F. for the control of brown rot. It was thought that this experience in California would be a fair guide for the tolerance of citrus fruits for the hot borax bath, and our first tests were made at 120° F. with exposure for five minutes. The internal temperature of the fruit in such brief treatment was not greatly raised, and the quality of the fruit was not adversely affected. Under the rather moist holding conditions maintained in the tests so as to promote rot, the hot treated fruit maintained a normal plump appearance, with however a distinct surface deposit of sediment or grey bloom. This hot treatment increased the effectiveness to over 90% for blue mold rot, and to about 80% for both forms of stem-end rot. The hot borax treatment is being tried in two or three packing houses in this state. In some cases an "aged" appearance has developed in the fruit after hot treatment; it has been found advisable to try lowering the temperature to 106 or 108° F., and to remove some of the borax with a 2½% borax spray or a water spray as it leaves the borax tank. This procedure is being tried extensively in California. Experimental tests have shown that each of these changes is in the direction of lessened effectiveness of the hot treatment, and the combined result would probably give an effectiveness intermediate between the cold borax dip and the 5-minute bath in 5% borax at 120° F. The fruit so treated has been arriving at market in a generally satisfactory condition, as has that from a number of packing houses in which the cold dip is used. Whether severe shipping conditions would show material difference between the cold and the moderately hot treatments remains to be seen. It is still too soon for a final conclusion as to the exact temperature and concentration and degree of removal of borax deposit that will give the highest degree of effectiveness with due regard to highly attractive appearance of the fruit on the market. It is not unlikely that discriminating buyers will not object to a little borax on the fruit for the same reason that some people like to have visible evidence that apples have been sprayed —to have assurance of good keeping quality.

An installation for the hot treatment must include a tank of sufficient size to give approximately 5 minutes in the hot borax solution; a device to keep the fruit properly submerged and to insure a slow enough passage through the solution; suitable heat piping in the tank, and a boiler or other means for supplying the heat. The cost is greater than for the cold treatment on account of more expensive installation, fuel, attention to operation and regulation, and larger amount of borax thrown away in renewal of the solution, when necessary, in the larger tank. Even with these items figured in the hot borax treatment ought not to cost more than two or three dollars a car when the

equipped unit is working at full capacity.

Under Florida conditions, with stem-end rot to be considered as well as blue mold rot, and with little difference between hot and cold treatments in effectiveness against the former, it may be that the cold treatment will meet most of the requirements for ordinary shipping conditions, and certainly offers a convenient and inexpensive means of trying out the method. Under very trying shipping conditions the added effectiveness of the hot borax treatment would certainly be desirable; but this treatment must not be pressed to the point of market loss from sediment or aged appearance. Ordinary hard water as well as soft water has been used satisfactorily for the cold borax treatment. Even with the hot treatment it seems unlikely that chemical reactions taking place between the borax and the dissolved mineral salts in the water would materially lower the percentage of effective borax, or produce enough sediment to form an unusual objectionable surface deposit. There is some evidence that surface deposit sometimes becomes gradually more prominent with ageing of the solution in the tank after using a week or ten days, even in the cold treatment. To keep tab on the strength of solution, hydrometer and temperature readings are taken, and the corresponding borax percentage looked up in a reference table. An effective strength of solution must be maintained and excessive concentration avoided. Intelligent supervision is required for this.

It must be remembered that even small amounts of borax in the soil affect growing plants of various kinds to a serious degree, and the disposal of waste borax solution must be watched with this in mind. The addition of hydrated lime to the borax solution some hours before the tank is emptied will convert much of the soluble borax into an insoluble form and lessen the chance of its injuring vegetation.

Whether or not the borax treatment will completely replace any of the older methods of controlling either blue mold rot or stem-end rot remains to be seen. At its best it is not 100% perfect, and the part of wisdom is to go slowly in modifying established methods of control and note carefully the effects under all sorts of conditions,—to regard this new chemical method of control as an additional fighting unit in the warfare against these destructive rots of citrus fruits. Its use gives promise of extending the market range for citrus fruit, and of increasing consumer-satisfaction, as well as of lessening losses from rot in transit.

Member: I would like to ask about the drying of this fruit. Does the test show there is any difference in drying after the borax is used, and is there any difference between the hot and cold?

Dr. Fulton: If anything, the cold borax solution dries more rapidly than the water. The hot solution certainly dries very much more rapidly than water.

Mr. Warner: I would like to ask regarding the methods of heating that water. What methods have you?

Dr. Fulton: I am going to ask Mr. Andrews to answer that if he will.

Mr. Andrews: Recently I have been to California. It takes considerable heat to carry on 110° or 112° treatment. In the Winter Garden houses, for instance, we have as high as a 15 horse-power boiler, which on cold days is working to capacity to maintain 120 degrees. In California, where they have natural gas, they generally use low pressure steam boilers. There were about twenty houses using them, of maybe 5 to 8 and 10 H. P. It will develop that for a six car house you would have to have a 6, 8 or 10 H. P. boiler to hold the water at 106 or 108°, and be sure you are going to protect your fruit on a cold day.

Two or three things we have observed in a practical application might be of interest. This white deposit on fruit that Dr. Fulton speaks about. If we put borax through our washers we find the rolls get a little whitish appearance. Sometime ago in Winter Garden, the deposit was so bad that they were going to discount the fruit on the New York market on account of the white deposit. We had to spend a day to boil those rollers and get the mixture off. If you have a wooden roller, run the drier for 8 or 10 revolutions, and spray with warm water, and you get that deposit off.

We have found in buying borax — there is a fine pulverized form that you buy for household use. If you throw that into a tank for the cold borax treatment, it takes a long time to dissolve. It is much better to take a crystal form, one-quarter inch in diameter. Then the water can circulate through the crystals, and they will dissolve away and go in the solution much quicker.

Member: This might be of interest. We put in a hot borax plant in December. Previous to putting it in we were getting on the average of 5% to 10% decay under ice, and since putting in the plant we have shipped in the neighborhood of 75 cars with less than 1% decay, using the hot treatment. It took exactly five minutes for the fruit to go through and in heating the solution to 105°, the fruit got in dry — it burned the fruit up. After shipping 8 or 10, we cut it down to 85° of 5% solution. That held up 14 days. One sample out of ten would be 100% perfect, and I have found only one decayed orange at the end of fourteen days in any sample that we have had. We never had any trouble with borax on the fruit, but we still get reports on its being aged and dry when only heated at 85°. At another house we tried the cold borax, with no results. In this house here, it is washed, and goes in at 85°, and from there into the drier and through the polisher.

At the Clearwater house, after trying out this cold borax solution, without results, I put in what is called an alkali special by-product. We were shipping under ice with decay, but since using that we ship getting 1% decay, while a neighboring house, shipping under ice, is getting more decay than we are.

I am still using one solution in one house, and the other in the other. In heating the water at Valrico I use two gasoline drums, with an ordinary cast-iron coil, and have a circulating pump to pump the water out and back into the vat. On a warm day, I keep water at 85°. I made a 5% solution, and at 85°, by

using an ordinary hydrometer, I tested it with that, in order to find what I knew was 5% solution.

The other is about a 2% alkali Special; I buy it at Mr. Skinner's place at Dunedin.

Mr. Chase: I was in California the latter part of January or the first part of February, and I visited some of the packing houses out there that are using the borax solution. California fruit is troubled with blue mold. Our trouble comes mostly from stem-end decay, so we can't confuse the California experiments with Florida experiments. One of the big packing houses of the California Exchange was one of the first houses to make a trial test of the borax solution. Last August or September they shipped 37 cars and out of the 37 cars there were 30 cars that went through without any decay whatsoever. There was a 1% decay discovered in the balance 7 cars. Those cars moved under ventilation.

The U. S. Department of Agriculture had two very good men in charge of the work at that point — Mr. Lon Hawkins and Mr. Barger, and they gave me all their data, and showed me all their machinery and equipment. They advise a temperature of 110°, and they keep the solution hot. They were under the impression that it would be advisable to have the hot solution here, but from the experiments that have been carried on in the Florida packing houses, and the appearance of fruit at destination, I am rather of the opinion that it would be rather dangerous for Florida to make use of the hot solution. I also am of the opinion that it is too hot. If it went up to 110°, which they thought in California would be the desirable temperature, I think it would be too hot. 85 degrees would be all right. They thought at that time it would be necessary to have a hot solution in order to bring about a penetration of the borax solution, but I have found out since that they have been unable to find any penetration. They are trying to determine now whether there is a penetration, and a benefit from that penetration.

There were a number of other interesting matters I ran across in California that would be of great interest to the Florida growers. I visited Mr. Shammel, at Riverside. Mr. Shammel, we all know, has done more in citrus bud selection than anyone else, I suppose, in this country. I ran across him first in 1911, when he was beginning his work. After that they permitted him to carry on some very extensive experiments in Riverside, and the results of those experiments show that the bud runs through to the parent tree; that is if it has good qualities they are perpetuated in the bud; if they have bad they also are perpetuated in the bud. Mr. Shammel showed me some trees that were the result, purposely, of defects in the parent tree, that came out in the bud. If they were shy bearers, it showed up in the bud. If they were extensive bearers it showed up in the bud, and I feel that the knowledge gained by Mr. Shammel would be of inestimable value to the Florida Citrus Industry. I brought that matter up to Mr. Shammel to see if his services could not be assigned to Florida for a period, so we could get the benefit of his knowledge, and perfect some mistakes that I know are going to be very

expensive, unless something along those lines is done. Mr. Shammel seemed to think that if possibly strong enough appeal went up to headquarters he could be transferred from California, and the Florida citrus industry would get the benefit, and I would like to see if something could not be done along those lines at this meeting.

Mr. Skinner: Prepare a resolution, and bring it in a little later in the day, please.

Member: I would like to ask about the time during which the fruit is saturated, —whether he has experimented with a lesser period.

Mr. Fulton: Yes, we have simply wet the fruit with a cold solution, and will bring just about as good results as soaking for four or five minutes, provided the wetting is thorough. With the hot solution it is necessary for the fruit to be in something like five minutes, in order to get the skin warmed up, and get the benefit from the temperature.

Mr. B. C. Skinner: What is the effect of the borax on the drying of the fruit? I believe he was answered that the fruit dried more readily with it than without it, and that is contrary from what we get from the machinery end. Complaints are that if we put borax on we can't get the fruit dry. I was wondering if Mr. Andrews had any experience in the Winter Garden house on the drying end of it.

Mr. Andrews: With the cold borax I believe we have noticed that it dries a little bit slower; with the hot borax, the heat that is applied to the skin of the orange furnishes the heat of evaporation, and while the Winter Garden drier is very inefficient on account of being rebuilt, we are able to get it dried, except on a very cloudy morning, but with the cold borax I believe there is cause for complaint on a little slower dry.

Dr. Fulton: In making my statement a while ago I was thinking about the drying where there is an equal amount of moisture. Ordinarily when the borax treatment is used I find the fruit comes in with more moisture on it. because ordinarily more or less of the surplus moisture is taken off.

Mr. Barney: Do you heat the air that you pass through the drier?

Mr. Andrews: It has been tried. Arcadia tries cooling the air, which serves the same purpose. They put lots of ice before the fan, and wring the moisture out before it goes in. Winter Garden now has a heating arrangement to heat the air.

Mr. Warner: I don't quite understand about the ageing effect.

Dr. Fulton: That ageing effect is puzzling us also. It is still in the investigation stage.

Mr. Allen: Does this borax in any way affect the eating qualities of the fruit?

Mr. Skinner: Not at all.

Varietal Names and Their Control

E. L. Lord, Gainesville, Fla.

The Chairman of the Committee on Nomenclature sent out a questionnaire to 1070 nurserymen handling or supposed to be handling fruit plants. Approximately one third of these nurserymen sent in replies. The replies included all of the more important nurserymen in the state, many of the growers of the state, and also many of those handling small amounts of fruit plants. It was no surprise to find that many unsatisfactory varieties were catalogued, and many newer varieties of doubtful merit.

There are catalogued in this state at the present time, as far as we have been able to obtain information, about 40 varieties of round oranges; of which not more than six or eight have sufficient value to justify recommendation for commercial planting. While many of the twenty varieties of grapefruit may be marketed commercially when there is not an oversupply, not more than three or four should be recommended for commercial planting. The condition found true for the citrus fruits is also true for other fruits planted.

Immediately on studying such a list as we have obtained the conclusion is made that there are too many varieties. This certainly is true in one sense. There is no doubt that the horticulture of this state is carrying on its back an enormous load of deadwood in the form of doubtful and antiquated varieties that are of little commercial value at the present time. There is also little doubt that there is a dearth of varieties of commercial value suited to the various requirements of season, market and regional peculiarities of the state.

Is there nothing to be done about it? In the past we have had a Committee on Nomenclature whose function was to weed out the obsolete varieties and standardize the nomenclature of those remaining. If anyone wishes to go over past lists and examine the much larger lists of citrus varieties grown a generation ago, he will find much material for thought. For example, in the Florida State Horticultural Society Report for 1907 the Committee selected 33 varieties of round oranges as worthy of mention; of these thirty-three, thirteen are not found in the catalogs of nurserymen to-day, seven others are only listed by one nurseryman, and may be considered as becoming obsolete. This is direct evidence to show that standardization tends to eliminate varieties. In spite of the enormous increase in acreage we are planting fewer varieties than twenty years ago.

Dr. U. P. Hedrick of the New York State Station has recently stated that the prime method by which horticulture advances is by the production of new varieties, or by the growing area of older varieties. This is no doubt true, and I believe

the members of the Society will agree with me when I say that it would be a grave misfortune if the activities of the Society should in any way prevent the production and testing of varieties. However, the commercial grove is no place for this testing and if any grove owner wishes to test out varieties he should separate his test plot from the remainder of his grove. In many ways he will find it an expensive luxury.

The old seedling grove is fortunately passing, and it seems proper to call attention to the fact that we owe most of our varieties to the planting of seedlings. Anyone who planted a seedling grove initiated a breeding project, and the millions of seedlings planted have been the principal source of new varieties. If we eliminate the seedling grove, as we are doing, what can we substitute for it that will be as productive of new varieties? If we do not produce new varieties we will stagnate, if we disseminate new varieties without proper and authoritative testing we will cause enormous property loss among growers who are and should be looking forward to better varieties than we now have. There is only one agency which is sufficiently impartial and can get sufficient means for the production and testing of varieties. This agency is the Agricultural Experiment Station.

It appears to the writer, who is not a member of the staff of the State Experiment Station and therefore may discuss this matter freely, that the fruit interests of this state are overlooking an important advantage when they do not back the Experiment Station to the limit in the testing and breeding of new varieties. The state has had some help in the past from private individuals, especially nurserymen, and from the Federal Government, but it is primarily a state problem and it can only be properly solved when the growers of the state insist that this type of horticultural work be adequately supported. In a state so preeminently horticultural it is a crying shame that we have been muddling along on this important problem for so many years with such meager results. Many other state stations have carried on breeding and testing work for years with valuable results; these states had comparatively few local problems, as neighboring stations could supply them with much vaulable data; but little from other stations that has to do with climatic adaptation of varieties is of use to Florida horticulture; there is no doubt that we may learn much by the study of methods, but the actual facts must be ascertained here, as there is no other state which has a similar climate, or a similar type of horticulture. Breeding and testing projects cost money and extend over a long period of time; they require continued and unremitting effort on the part of those conducting them, and changes in the personnel of those in charge of them are disastrous.

It is the custom to talk about fruit production and consumption without bringing up the question of varieties. This is a grave mistake. The question of marketing grapefruit to advantage would be much simplified if we had seedless varieties which could lengthen the grapefruit season so that Florida could market grapefruit throughout the year. The substitution of a seedless variety of round or-

ange which colors in early October for the lamentable Parson Brown will help to solve the problem of the marketing of immature round oranges and the doubtful practice of coloring early oranges. The Pineapple, no doubt a wonderful variety, has several faults. The shipper of oranges overlooks the fact that the consumer at the other end of the line compares this same Pineapple orange with well opened seedless Washington Navel oranges from California, and sees no reason for sorting twenty seeds out whenever he eats an orange. From the marketing standpoint this is the principal drawback to this variety, but its short season and misbehavior on light soils and rough lemon stock have done much to discredit it as a midseason orange. With all of the faults it is the standard commercial round orange of its season, but in certain sections such as the Eastern portion of Central Florida, other varieties are supplanting it. The fact that the Pineapple has been the most extensively planted midseason orange accounts for the sharp rise in prices in the few weeks before the Valencia season started; this year, the man who grew Pineapple oranges had shipped all of his fruit or it was lying on the ground. It has been said that we know most of the varieties of fruit by their faults, and if you think that this is not true, run over in your mind the varieties of citrus with which you are familiar. The great eagerness with which growers plant out new varieties is conclusive evidence of the faults of the old varieties.

The question of variability among varieties should be discussed here. It is the fashion to blame most of the unevenness in production and type to bud varieties, but this is probably far from the case. The fact that many of the early groves were seedlings and that many varieties come almost true to seed has resulted in a curious state of affairs. Certain variety names as generally understood by the growers are not names for clonal varieties, but of seedling strains, similar to such names as Jersey Wakefield. Due to the fact that some of these seedling strains have been perpetuated by budding it is very evident that certain variety names are group names. This is evident in such a name as Valencia. This term is used to include a group of late oranges that are nearly seedless. At one time some of this group had separate names such as Hart and Tardiff, but these varietal names were erected on minor differences, so that at present the grower groups them all as Valencia. The pomological description of the Valencia is a composite and represents several clonal varieties. Many of the so-called bud mutations are nothing but seedling varieties that have gotten into our nurseries. It is highly desirable that the best type of the Valencia group be perpetuated and the others consigned to oblivion. In consequence the Lue, a Valencia seedling of the most desirable type and a strictly and correctly named clonal variety may be recommended, rather than such an indefinite group as Valencia. Where the Valencia type of orange is to be grown the Lue will become the standard. This only applies to new plantings, as on a commercial basis there is little difference. Ordering the variety Lue from the nursery will insure

getting a desirable type of this group. The so-called Satsuma is likewise a group name, and only desirable varieties of this group should be propagated. The Mexican Lime is another illustration of this condition, as the name represents a variable mass of seedling forms.

The question of variability among varieties does not stop here. As any citrus grower knows, soil, stock, and climate affect the quality of fruit borne by any clonal variety, so that a description can at the most only be accurate where the variety is grown under normal conditions, whatever these are. No group of horticulturists can tell exactly the commercial limits of a variety, particularly this is true of citrus, as the discovery or exploitation of a new stock may at any time greatly extend the profitable limits of any variety.

The question of varieties is complicated still further by the irresponsibility of a few nurserymen. As a rule Florida nurserymen are as fair and just as any in the United States, but there have been a few nurserymen whose methods have been highly questionable. It is a very questionable practice to rename an old variety and sell it at an increased price as a valuable new variety. Too much is also claimed for new varieties. Much trouble and expense could be avoided if publications would not accept the type of advertising which makes extravagant claims for new varieties. This is not an imaginary condition. The Florida Marvel Blackberry is an illustration. This variety has been in cultivation in the state for quite a number of years. It originated as a chance hybrid at New Smyrna, and was introduced as the Ballou Berry, after the man who disseminated it. At various times it has been called Ballou Berry, Volusia Berry, Daytona Berry, Australian Berry, Marvel Berry and Florida Marvel Berry. According to Code of Fruit Nomenclature of the American Pomological Society it has as good a right to the name Ballou Berry as to any other name. A variety of Raspberry, belonging to a tropical species, Rubus ellipticus, which has been sold in California under the name Golden Evergreen, and by a nurseryman in this state under the correct botanical name Rubus ellipticus, has been widely distributed under the name of Yellow Jacket Raspberry. Such practices as those mentioned above tend to bring all new varieties into discredit. There is no doubt that the commercial grower had better stick to standard varieties, and be sure of what he is doing when he plants any variety extensively.

How may we avoid this confusion of names and excessive duplications? Probably the most promising method is for some impartial agency, such as the Experiment Station, to make and keep both in herbaria and test plots, type specimens of all varieties of fruit grown in the state, properly labeled, and accompanied by accurate descriptions and photographs. A Standing Committee of the Society could co-operate with the Station in keeping the fruit list of the Society published in each report of the Society and revising at stated intervals, preferably every three or five years. Nursery catalogs should be kept up to date and all synonyms kept out of them. Every nurseryman should have a copy of Standardized Plant Names,

which is a catalog containing the proper scientific, common and varietal names of the various fruits and other horticultural plants. This catalog is prepared by the joint committee on Nomenclature of the various horticultural societies of the United States. The joint committee attempts the standardization of both the common and scientific names of cultivated plants. There is no doubt that the horticulture of Florida will be benefited by close co-operation with such an important national agency. But the problem of breeding, testing, and disseminating new varieties is a local one, and must be carried on by agencies in this state. The State Experiment Station must lead in this work, and the Horticultural Society will no doubt give it the hearty and interested support that it has in previous years. With these two valuable organizations working together there is no doubt that horticulture of the state will adjust itself to its growing needs.

Report of Committee on Nomenclature

We recommend to the members of the Society the adoption of the revised Code of Nomenclature of the American Pomological Society, a copy of which is appended to this report. In accordance with this code there is also appended a list of the principal varieties of fruits grown in this state. The committee realizes that this list is not complete, and asks that the members bring to its attention anything that should be amended or corrected.

We deprecate the practice, altogether too common, of widely disseminating claims as to the merits of varieties, which at the most can only be partially true, and in some cases at least are false and untrue. This can not and should not be interpreted as a criticism of the development of new varieties or the trial of old varieties in new localities. The principal method by which horticulture advances is by the development of new varieties, but wholesale planting in advance of experimental work is wasteful and uneconomic, both to the individual and the state.

Your committee believes that the practice of a few nurserymen of operating a nursery under several names is confusing and unethical, that the use by one nurseryman of a title or address similar to that of another nurseryman is unfair and improper, and we ask that members of this association do everything in their power to make public such situations, to the end that nurserymen will come to realize that such methods are not permanently profitable.

We as a committee believe that publications have a certain duty to their reading public, that it is their business to see that nurserymen of questionable practice are barred from their advertising pages, and that the burden of investigation and blame lies upon the publication accepting such advertising. It is also the duty of the members of this Society to bring such questionable advertising to the attention of any publication which carries the same unknowingly.

The committee earnestly recommends to the nurserymen that they propagate as few varieties as possible consistent with the demands of their location and trade; that varieties which have only a historical or sentimental interest be discontinued; and that they use due care that varieties are catalogued under the standardized name as recognized by the Committee on Nomenclature of the American Pomological Society.

In connection with the practice of limiting the number of varieties the committee recommends that there be some provision made for the testing of promising new varieties. This work should be done by State and Federal agencies, but it is believed that these agencies should have the co-operation and assistance of the

nurserymen and growers. Definite provision should also be made that will make the breeding of new fruit varieties and rootstocks a project backed by the horticultural interests of the State. The unique climate of Florida makes such provision imperative, if the state is to hold its preeminence in horticulture. As the seedling groves and trees are rapidly disappearing, organized plant breeding must be resorted to or stagnation in fruit growing will result. It must be emphasized that the principal way in which horticulture advances is by the development of new varieties. Private individuals should not be made to bear the expense of what is so largely a public benefit.

The committee does not believe that it is necessary or desirable to catalog all of the fruit varieties grown in the state; it simply indicates the varieties which appear to have the most promise commercially. The committee believes that the list should be revised at stated intervals; preferably after each two year period

Code of Fruit Nomenclature

American Pomological Society

This code aims to establish a simple and clear system of pomological nomenclature that shall be appropriate and stable. Accordingly it is urged that all persons naming new varieties of fruits choose simple one-word names that are fittingly expressive of some character, quality, place, person, or event associated with the source, time or place of origin of the variety.

The paramount right of the originator, discoverer, or introducer of a new variety to name it, within the limitations of this code, is recognized and established.

The term "kind" as herein used shall be understood to apply to these general classes of fruits which are grouped together in common usage without regard to their exact botanical relationship, as apple, cherry, grape, peach, plum, raspberry, etc.

I. FORM OF NAMES

1. Names of new varieties shall be of one word preferably, but two words may be accepted. Names of existing varieties shall not be changed in such way as to lead to confusion or loss of identity.

2. The spelling and pronunciation of a variety name shall be the same as that of the person, place, substance, circumstance, or quality from which it is derived.

3. A possessive noun shall not be used.

4. Initials should not be used as a part of a variety name.

5. A name shall not be formed by the compounding or hyphenating of two or more existing names, but this does not prohibit the formation of a one-word name by the use of parts of two or more existing names. The hyphen shall not be used between the words of a name. Thus, neither Bartlett-Seckel nor Bar-Sec may be used, but Barseck is admissible.

6. Such general terms as seedling, hybrid, beurre, damson, pippin, rareripe, bigarreau, should not be used.

7. A variety imported from a foreign country should retain its foreign name, subject only to such modification as is necessary to conform it to this code, and provided that names having a recognized English equivalent may be, but are not necessarily, so rendered.

8. The name of a person shall not be applied to a variety in his lifetime without his consent.

9. The name of a deceased person shall not be applied to a variety except through formal action by some competent pomological body, preferably that with which the deceased was most closely associated.

II. PRIORITY, USAGE AND DUPLICATION

10. The name first published for a variety shall be the accepted and recognized name except when contrary to the provisions of this code; but names established by usage in American pomological litera-

ture may be retained even though they do not conform to these rules.

11. A name once used shall not be used again for a variety of the same kind, except that a name once established through long usage for two or more American varieties shall not be displaced for either or radically modified unless a well-known synonym can be used in its place; or when such synonym is available, the varieties bearing identical names may be distinguished by the addition of the name of the author who first described each, or by some other suitable distinguishing term.

III. PUBLICATION, DESCRIPTION AND CITATION

12. Publications consist in: (1) The public distribution of a printed name and description or characterization of the fruit; (2) the publication of a new name for a variety described elsewhere under a different name, number, or other untenable designation, the synonym being given.

13. Publications of a name may be made in any book, bulletin, report, trade catalog or periodical or public distribution and bearing date of issue.

14. But a varietal name may be established by current usage in the locality of its origin, when well-known, and shall be considered as published and have precedence over a later printed name for the same variety.

15. Complete description of a variety consists of a detailed account of the characteristics of the plant, foliage, flowers, fruit, and habit of growth, so as to distinguish it from other varieties of similar appearance.

16. The type of a variety is the fruit of the original plant; and type description or illustrations shall be made from material produced by the original plant, or when this is not available, from a plant as near as possible to the original in a sexual reproduction, and preferably grown in the same pomological region.

17. The full citation of a variety name consists of the name of the author who first described the variety, and the name, page, and date of the publication in which the description first appeared. An author-citation following a name refers to the author of the original description of a variety; e. g., Turley, C.P.C. Names of the authors and published works may be abbreviated, in accordance with the usages of this Society.

Adopted November 8, 1923, at the New York Meeting of the Society.

Activities of the Growers' and Shippers' League of Florida

J. Curtis Robinson, Secretary-Manager Growers and Shippers League of Florida, Orlando, Florida

The perishables industry has increased from year to year until today there is shipped out of the State annually a full carload of perishables for every four and one-half minutes of the entire year.

Numerous transportation problems have confronted the growers and shippers of citrus fruit and vegetables from Florida for a number of years. Some of these problems have been very vexatious and troublesome.

Individual shippers found it impossible to spare the proper time from their regular duties to give their attention to all the numerous and weighty transportation questions affecting the fruit and vegetable industry. Likewise it was considered too much of an imposition on one shipper or individual organization to attempt to handle all of these problems. Individual organizations did not have at their disposal statistics of their competitors, which are sometimes very necessary in presenting matters affecting rate adjustments.

A number of the leading growers and shippers of the State, realizing the keen need for a central organization through which the shippers might function in looking after the larger transportation questions, formed the Growers and Shippers League of Florida and agreed to contribute thereto the small sum of 50 cents per car toward its maintenance.

The League was organized in December, 1923, for the purpose of handling all the great questions which affect the citrus fruit and vegetable industry in Florida, such as railroad and refrigeration rates, general rules and regulations governing railroad claims, State and Federal legislation applying directly to the citrus fruit and vegetable industry, and other questions, aside from marketing, which seriously affect the upbuilding of these industries.

A Secretary and Manager was employed whose attention, in addition to handling the various smaller matters which have come before the League for attention, has been generally directed during the last year to an analysis of the rates applicable from Florida to the various markets in comparison with the rates on similar commodities from other districts.

For a long time our shippers have felt the need for a readjustment of the transportation charges on perishables from Florida to the various markets. The railroad rates on perishables from Florida have been under review by the Interstate Commerce Commission on many occasions when the volume of tonnage produced in Florida and the population of the State itself was much more meager. The rates established by the Commission at

that time have been subjected to various general percentage increase and one 10% reduction.

On February 12, 1924, statistics and argument for an emergency reduction in our line-haul rates was presented by the League to the traffic officials of the railroad lines serving Florida as initial carriers, in an all-day conference at Jacksonville. After considering our proposal and conferring with their northern connections, the railroad officials announced they were not in position to give us relief.

Since that time many conferences have been held with our State Railroad Commission, Mr. R. Hudson Burr, Chairman, Senator James E. Calkins, Counsel, and Mr. J. H. Tench, rate expert, where our rate situation has been considered quite fully.

Upon our showing, a complaint against our line-haul rates on citrus fruits, vegetables, melons, pineapples and strawberries from producing points in Florida to all destinations was filed by our State Railroad Commission on March 30, 1925, with the Interstate Commerce Commission. A place and date for hearing will be set at some time to be decided upon later by the Commission. Evidence has been prepared at very great cost and will be presented to the commission which showes the Florida rates are unduly high, and if reductions are obtained, which we confidently believe the evidence shows are justified, it should mean the saving of several millions of dollars to the growers and shippers of the State annually.

At the time of the organization of the League there was confronting the industry a proposed increase in the refrigeration charges from Florida. Evidence was accumulated, prepared and presented by the aid of the Railroad Commission of the State, and its counsel, and the proposed increase in refrigeration charges was defeated. It was also proposed by the carriers to adopt a rule in the tariff requiring three hoops or straps on each box of citrus fruit. This proposal was likewise opposed and defeated. The carriers proposed a charge for the use of dry refrigerator cars and this proposal was opposed and defeated. The carriers published a tariff for a charge of from $5.00 to $15.53 for the use of a dry refrigerator car in which to load precooled vegetables. Evidence was prepared by the League and at the hearing a compromise was reached with the carriers whereby the tariff was withdrawn and the shippers withdrew their complaint.

The carriers then proposed to increase the weight on standard boxes of grapefruit from 80 to 85 lbs. and on standard boxes of oranges from 80 to 95 lbs. on the proportional rates applying from interior Florida points to Jacksonville, when destined to Pacific Coast and intermountain territory. This made an increase of $16.38 per car on oranges and $5.94 per car on grapefruit Orlando to Jacksonville. A complaint was filed by the Railroad Commission on request of the League. A hearing was held, and evidence which had been prepared by the League was presented. The Commission upheld the contention of the shippers that the weight on oranges and grapefruit and the proposed method of assessing rates in cents per 100 lbs. instead of per box to Jacksonville, should be cancelled.

During the season 1923-24 the celery shippers in the Manatee and Sanford districts were compelled to load short refrigerator cars which would not properly refrigerate or safely transport the minimum of 350 crates of celery. A complaint was filed in behalf of the shippers by the Railroad Commission, and the League assisted the interested shippers in presenting their evidence before an Interstate Commerce Examiner at Orlando to show that the short refrigerators which had been furnished were unsuitable and that the shippers were entitled to reparation.

This case, known as Docket 16177, is now pending before the Commission.

In the summer of 1924 the shippers of green corn and other vegetables, desiring to place ice on top of loads of vegetables in order to insure more intense refrigeration and the delivery of their produce in the market in good condition, were denied the privilege by the carriers. Mr. R. Hudson Burr, Chairman of the Railroad Commission, and State Marketing Agent Rhodes, visited the Interstate Commerce Commission at Washington, D. C., in behalf of shippers, and by their assistance prevailed upon the carriers to permit this practice to be continued during that season. During this past season it was again denied the shippers by carriers, although the tariff, which is published and on file with the Interstate Commerce Commission, plainly reads that the carriers will not, except *upon request of shippers*, place ice on top of the load in a refrigerator car equipped with ice bunkers.

For a while this season the shippers used top icing but later, after a complaint had been filed against the railroads, the carriers in Florida have denied the privilege to shippers, and have since persistently refused to permit shippers to place ice on top of the load of vegetables in refrigerator cars on any shipment from Florida.

Meanwhile the railroads in California, pending the decision of the Interstate Commerce Commission on the docket now before them, are permitting the shippers in that state to place ice on top of loads of vegetables which require it, in addition to the refrigeration afforded by the ice in the ice bunkers of refrigerator cars.

The case which the shippers brought before the Interstate Commerce Commission, assisted by the Railroad Commission of this state, and the League, was heard in Jacksonville on December 17th and 18th, 1924. Afterwards additional testimony was submitted in a later hearing at Washington, D. C. The case is now before the Commission for its decision.

Oral argument of our counsel will be made in Washington on May 14th and 15th. It will probably be thirty or sixty days thereafter before the Commission renders its decision.

During the watermelon season the state of Georgia declared an embargo against Florida melons moving into or through their state, claiming the melons were loaded in tick-infested pine-straw bedding. This promised to be disastrous to the melon growers. The League took the question up very vigorously with the authorities. The Governor of our state took a very active part in having the embargo modified.

Importers of Algerian grapes made an

effort to get the quarantine laws relaxed which would permit the importation of Algerian grapes. The League opposed this proposal and received assurance from the Department of Agriculture that no modification would be made in the present quarantine laws which might permit the importation of grapes from districts infested with Mediterranean fruit fly to enter the United States. This was of very great importance to the citrus industry of this state as this pest is particularly dangerous to citrus fruits.

ELIMINATION OF TAX ON TELEGRAPH AND TELEPHONE TOLLS

The League took a very active part in presenting to our Congressmen argument against longer continuing the tax on telephone and telegraph tolls. It is known this tax has now been removed, which saves thousands of dollars annually to the fruit and vegetable industry of our state.

On March 18th of this year the Federal Horticultural Board held a conference at Washington to consider placing fruits and vegetables from Porto Rico under permit and restrictions necessary to prevent the entry into the United States of certain pests known to occur in Porto Rico.

The League insisted that restrictions, quarantine laws or other regulations, sufficient adequately to protect the fruit and vegetable industry of Florida, should be continued in effect. The State Plant Board likewise sent a very strong resolution to the Federal Horticultural Board. Senators Fletcher and Trammel interested themselves in the plea of Florida shippers.

We are advised the Board failed to make out a case in defense of its proposal to place Porto Rican fruits and vegetables under permit, and the whole matter has been taken under advisement by the Board and its decision will be announced in the near future.

We are on the mailing list of various rate committees and receive their dockets of proposed changes in rates or minima. If these proposals affect the citrus fruit and vegetable industry, an attempt is made to protect those interests.

REGIONAL ADVISORY BOARDS

Formation of Florida Perishable Sub-Committee of the Southeast Shippers' Regional Advisory Board.

There are thirteen or more Shippers' Regional Advisory Boards usually covering from three to six states generally situated within the territory covered by the several District Managers of the American Railway Association. The Boards are composed of shippers, producers and distributors of commodities shipped by railroad. These are shippers' organizations. They deal with transportation service. They do not deal with rates. They are for the purpose of forming a common meeting ground between shippers, local railroads and carriers, as a whole, on matters of car supply, schedules and general transportation requirements.

The carriers appoint operating officials of their lines, operating in the various districts, to confer in these conferences with shippers, listen to their complaints and attempt to iron out their difficulties so the carriers' transportation may be made as nearly satisfactory as possible to shippers.

The Florida Perishable Sub-Committee

of the Southeast Shippers' Regional Advisory Board, with headquarters in Orlando, was organized November 15, 1924. The Secretary of the League was elected Chairman. We have held three meetings in Orlando. These meetings have been attended by shippers and operating officials of carriers serving Florida as initial carriers.

Some improvement in transportation conditions has been effected through these informal conferences. Where there were schedules in effect unduly penalizing shippers, it has been brought to the attention of the operating officials, and where possible it has been corrected to shippers' satisfaction. There has been no general car shortage. There were temporary shortages, due to flood conditions in Georgia, but by co-operation of carriers and shippers loaded cars were handled out of Florida and empties were brought into the state with a minimum of delay and inconvenience to shippers. I repeat, these are shippers' meetings. In order for them to be successful they must be generously attended by shippers. Complaints relative to car supply or any specific case of improper transportation should be brought to these meetings and presented directly to the operating officials in these round-table discussions. If you cannot get better results in that way then I do not know of a better way in which they can be obtained.

Until recently the League has had very little to do with general rules and regulations governing railroad claims. On March 17th a conference was arranged by the American Fruit and Vegetable Shippers Association between the Claims Committee of that organization and the Freight Claims Agents of the Claims Division of the American Railway Association for the consideration of claim problems of shippers of perishables in the United States. At that meeting it was proposed to form a National Perishable Claims Advisory Committee composed of representatives from shippers and representative Freight Claim Agents of the principal railroads handling claims on perishables, to serve as a contact point and clearing house for the settlement of principles governing the general claim difficulties of our industry. There are many things among railroad practices now hampering prompt settlement of claims which should be corrected. The League expects to take part in the consideration of these problems looking toward an improvement in the present situation.

It will be seen from this recital of only some of the activities of the League, that we are continually looking after the interests of the growers, and are fulfilling the mission for which the League was organized.

We recognize the growers' dependence upon adequate safe and dependable transportation. We are doing a constructive work. We present the growers' needs and demands fairly but firmly to the carriers who serve us with transportation. I feel I can safely say the carriers have proper respect for our record of fair dealing, and the growers and shippers whom we have served recognize the worth of a permanent, constructive central organization through which all may work with mutual benefit proportionate with the interests they represent.

Controlling the Citrus Aphis

J. R. Watson, Experiment Station, Gainesville

In the beginning I desire my hearers to appreciate the fact that we have been working on the citrus aphid only a year, a period of time altogether too short for the solution of any entomological problem, much less such a difficult one as this. We make no pretension that the problem is solved, or that we have anything final to offer, and at our next meeting we may have an entirely different set of recommendations to make. Nevertheless, in view of the seriousness of the situation and the vastness of the interests involved, we do not feel justified in withholding what information we have secured up to this time.

Since the first of the year the entire entomological force of the Experiment Station has devoted practically all of its time to this problem, and during the past six weeks we have been able to double our force and greatly increase our work, through the use of a State Plant Board Emergency fund released by the Governor and the State Plant Board.

The new citrus aphis is largely a pest of young trees. As it attacks only new growth, it is evident that it is most severe on trees that are most frequently throwing out new growth. For this reason it is going to be much more of a problem in groves on hammock and drained lands than on the high pine lands of the state. In fact in the latter situations we have not seen a single instance this season where we thought control measures would pay in the case of large seedling trees. But on young, non-bearing trees, and on most budded trees, and especially tangerines, Temples and King oranges, the insect is a first-class pest and one that will have to be fought.

Upon large bearing trees, fifteen or more feet in height, incomparably the best results have been secured this spring by dusting with a power duster, during quiet weather. For this purpose the best dust we can recommend at this time is nicotine sulphate lime dust, or nicotine dusts with a comparable killing efficiency. Where nicotine sulphate is the base of the dust we recommend the three per cent dust. Where dust known to contain three per cent nicotine sulphate has been applied to trees during quiet warm weather the kill has been so near 100 per cent that it has taken a long search in a dusted grove to find a single live aphid. Where dusting has been done in the wind, or carelessly done, of course, results are different. This dusting has cost from four to six cents per tree for the material alone.

Most of the nicotine sulphate lime dust used in the state during the past year has been purchased already mixed. Most of that used by ourselves in our experiments has been made at a saving of about 45%, that is, it has cost us about ten and a

third cents per pound. The method of making this dust is described in Bulletin 174 and need not be repeated here. I must caution my hearers, however, that in buying nicotine sulphate lime dusts they should buy only that guaranteed to contain actually three per cent of nicotine sulphate, not three per cent of forty per cent nicotine sulphate. You can readily see that the latter would contain only a little more than one per cent actual nicotine sulphate. Of course, these remarks do not apply to those dusts that do not use nicotine sulphate as the source of the nicotine.

Mr. Beyer has shown that finely divided tobacco dust, or so-called "snuff," is fairly effective when mixed with lime, though it is not as good as nicotine sulphate lime dust, but is much cheaper.

In the case of small trees it does not, of course, pay to use a power duster. There is too much material wasted. On trees from three to four years of age up to those on which a power duster may be used economically our best recommendation right now is dusting under tents — fumigation. Spraying is also efficient, provided (and this is an important point) the spraying is started before the leaves have been curled. For this spraying work one of the best sprays, safety and efficiency considered, is one of nicotine sulphate and soap, or "derrisoil," using the nicotine sulphate about one part to 800 and the soap at the rate of 6 or 8 pounds to 100 gallons. Nicotine sulphate in oil emulsion has also been used successfully, and it is to be recommended highly under conditions where it is safe to use an oil emulsion. The oil emulsion can be cut down to half the strength that is ordinarily used for whitefly and purple scale, and when mixed with the nicotine will still be very efficient in killing the aphids. Of course, one does not want to apply oil emulsions too strong nor too often to young trees nor to trees that are full of new growth, blossoms and young fruit.

We have had excellent results in the last few weeks on young tangerine trees by the use of the lime sulphur-tobacco spray that we have long recommended for thrips. A grove of young tangerines in Lake County was sprayed with this solution two weeks ago with most excellent results. However, this combination does not make quite as even a coating over the leaves as does the nicotine soap combination. There is more of a tendency for the lime sulphur to collect in drops. For this reason, if you are spraying for aphids alone probably the soap and nicotine solution would be preferable. When one wishes, however, to make a combination spray for red spider, and later on rust mite as well as aphis, or a combination spray for thrips and aphis, the nicotine sulphate-lime sulphur sprays can be used to good effect, always emphasizing the fact that the spraying must be done before any considerable number of leaves have been curled. After the leaves have once been curled it is very difficult to reach the aphids in the interior of the spirals with any spray. That is the chief reason why we prefer dusting.

Another reason is that it is much more difficult to cover a tree thoroughly with a spray than it is with a dust delivered through a good power duster. It has been recommended, based on experiments

in the North, that the temperature be 75° for the application of these dusts. However, we have had very efficient killing in Florida this spring where the temperature was as low as 65° or lower. Neither is it necessary to wait until the trees dry in the morning as was formerly thought and as is still stated on some of the cans in which the dust is sold. If the weather is clear and there is every promise of a fair day there is no reason why one cannot begin dusting at daybreak in spite of the dew, provided the temperature is not below 60°. Probably a lower temperature would be satisfactory if conditions seemed to indicate a rise in the course of an hour or so. Because of the absence of wind the early morning offers one of the best times for dusting. This much is certain, it is better to dust on a calm, dewy morning even if the temperature is in the 60's than in the middle of a windy day.

On very young trees up to two or three years of age (i. e., set in grove 2 or 3 years), we have had excellent control at the lowest cost by the dipping method. By this I mean dipping the infested twigs in a strong insecticide. Any insecticide strong enough to kill the aphids will do, soap, oil emulsion, lime sulphur solution, solution of derris, etc., but we rather prefer a soap and tobacco solution or derris-oil. A solution of one teaspoonful of nicotine sulphate, one eighth of a bar of laundry soap or an ounce of whale oil soap, in a gallon of water is plenty strong enough to kill the aphids,; it spreads well over the surface, and does not kill the syrphus fly larvae, nor the larvae of the lady beetles which cling to the tree. Any adult lady beetles that drop into the bucket and are allowed to float around in the liquid for any length of time will be killed. Some growers try to scare off the lady beetles by giving the young tree a shake before they dip it. However, this is apt to dislodge some of the winged aphids and for that reason is objectionble. Of course the lady beetles can be promptly fished out of the bucket when noticed. However, Mr. Thompson's work has shown that about nine adult aphids can produce enough young to keep a lady beetle or syrphus fly larva fed up. In other words one larva will ordinarily not eat over about 45 aphids a day and the average rate of reproduction is 5 or 6 young a day. This gives us some idea of about how efficient a lady beetle is in controlling aphids.

In one young grove in Lake County we have been able to protect the two year old trees from any serious curling by four dippings and a couple of spot dustings. By this I do not mean to say that every tree has been dipped four times, but the grove has been covered four times, and all infested twigs found have been dipped. The total cost has been less than five cents per tree. The growth is now hardening on these trees and it is not probable that they will have to be dipped again unless the biological control should be delayed so long that the June growth becomes infested. Five cents is certainly not a prohibitive price to spend on a two year old tree in a season.

This dipping can also be used on larger trees where the infestation is not general, where only a branch here and there shows the aphids. The most serious problem

presented in this dipping program is that of the small sprouts coming out in the interior of the tree, sprouts so short and tender that they cannot be bent over into the bucket. Such sprouts can either be washed off with a sponge carried for this purpose, or sprayed with a small hand sprayer carried along, or they can be spot dusted. Indeed, spot dusting and dipping go well together on young trees. The portions of the tree most easily dipped, namely the ends of the branches, are the very ones most difficult to spot dust, and vice versa, those short delicate twigs on the interior of the tree most difficult to dip are the very ones that can be spot dusted most effectively.

Dusting trees of any considerable size with a hand duster when the infestation has become general over a tree has been somewhat disappointing. Our experience as well as that of Mr. Wilson, of the Agricultural Extension Division of the University, has shown that a small block of trees in a severely infested neighborhood will have to be dusted twice a week and that the cost is high. In other words, the owner of a small, door-yard grove surrounded by growers who do nothing is going to have an expensive fight if he depends on a small hand duster with which to combat the aphids.

Dusting with a power duster on large trees is probably the cheapest method of dealing with the aphid, and is very effective, *if there is no wind.* But the least wind seriously interferes with the efficiency. In order to get a 99% kill (and a percentage much below that is inefficient) the cloud of dust or "fog" should hover over the tree for at least a full minute. If there is sufficient wind to prevent this, dusting in the open should not be attempted. Unfortunately such calm days or nights are rare during the aphid season. Sometimes it has been necessary to wait a week or ten days for favorable weather. These circumstances have impelled us to experiment with dusting under tents. Several types of tents have been devised and tried out. Some of the most successful are shown in the photographs we are passing around.

For trees up to 8 or 9 feet in height we have found tents made in the form of half a cone to be very handy. For larger trees these tents have a frame work made of 5/8 inch gas pipe. The open side of the cone is provided with a flap, one edge of which is fastened to the tent, the other being left free. These tents have an advantage in that they do not have to be lifted over the tree, but by throwing the flap back, they can be moved up against the tree without much lifting. They have a further advantage in the ease with which the tree can be dusted; one man can hold the flap open while the other man dusts the tree thoroughly, thus assuring an even covering. Other tents are made in the form of a complete cone. These can be rolled and lifted over the tree. The dusting is done through the flap in the side of the tent. This type of tent is preferable for small trees from 1 to 2 years old up to 6 feet in height. For the larger trees we have used the regular California octagonal tent which is pulled over the tree. One man holds up the side of the tent while the other dusts the tree. Another type of tent is provided with a hoop at the bottom and a

wire cap-like arrangement at the top. They are a little more trouble to put over the tree but are much more easily transported than the other types.

We have found dusting under these tents to be more thorough and dependable in that the dusting can be done in any weather, provided it is not actually raining. The wind is no hindrance. In fact, with the small conical tents provided with a flap the wind is an advantage in that it keeps the flap and also the dust inside in constant motion.

With a battery of a dozen of these tents it is easy to fumigate an acre of trees in an hour. The number of men required will depend on the size of the trees, and consequently of the tents. For small trees just set out one man can manage the entire job of moving the tents and dusting. For the larger trees and tents 3 or 4 men can work to better advantage, two to move the tents and two to do the dusting. For large acreages the most efficient arrangement will be 15 or 20 tents and 6 men, 4 to move the tents and 2 to do the dusting. With this number of tents and men two acres an hour can be dusted. The saving of dust in this method almost compensates for the extra labor of moving the tents from tree to tree. A ten acre tangerine grove in which the trees averaged 7 feet in height was dusted at a cost of 8 mills per tree for the dust alone. In another grove where the trees were somewhat larger, 8 or 9 feet high, the cost was one and one-fourth cents. In both cases the cost was figured on the cost of home-made dust. In each case the kill was about 99.7%. In these experiments we used three per cent nicotine lime dusts.

Some experiments that are now in progress indicate that calcium cyanide dust can be used if the humidity is low and the trees are perfectly dry. It may be found practical to kill not only aphids but scale insects at the same time by the use of calcium cyanide. Experiments are now under way to test this out.

It is our belief that this dusting under tents, all things considered, is the most practical way of dealing with aphids on small trees. One fumigation will ordinarily suffice to keep the trees reasonably free of aphids for a week or ten days.

Aphids do the most damage in the early stages of growth of the citrus. When the leaves are half grown or more they will support a rather surprising number of aphids, and the same is even more true of the blossoms and fruit. In a number of cases we have seen blossoms and fruit that were covered with aphids and yet they were able to develop and set fruit almost as well as those from which the aphids were carefully kept off. But it is in the very early stages of growth that the aphids do their worst damage when the tiny sprigs are just pushing out from the wood. Often these young twigs will be covered with aphids before they are half an inch long and growth completely stopped. Such trees continue to throw out buds thus giving the aphids a continual food supply. The result is that the tree is very seriously checked in its growth, the amount of fruit produced is greatly diminished, and sometimes the tree is actually killed. Thus it is in the early stages of growth that the tree should

be most carefully watched for aphids and the most energetic measures taken.

A great deal of the dusting and spraying that has been done this year has been done too late as the leaves have been curled and hardened up so that the aphids were left unharmed by the spray. Spraying at this stage is money wasted.

Another reason for instituting control measures when the flush of growth is just starting out on the trees is that at such seasons there are very few winged aphids about. The aphids develop wings only when the foliage begins to harden up. This means that trees freed of aphids in the early stage of the flush of growth will not be very quickly reinfested by aphids flying in from neighboring groves. Later, when most of the growth is hardened up and there are plenty of winged aphids about, this reinfestation is very prompt, and at this time the nicotine sulphate lime dusts will keep the grove from the migrating aphids only about 24 hours.

No citrus insect we have demands such thorough measures as does the citrus aphis. As a corollary to this I will say that the citrus aphis present more of a community problem than any other citrus insect. This is because of its rapid spread by means of the winged individuals. Never before in the control of citrus insects in Florida has there been such a necessity for small growers, owning contiguous groves, to co-operate in fighting a common pest. In case of the larger grower, particularly if the grove is more or less isolated, the control is much simpler. Small growers in a community must co-operate.

One very peculiar thing has been observed this season in regard to newly set young trees. Those set in December or the very first part of January have practically escaped any injury from the aphis. We have observed numerous cases of such trees growing in a grove close to trees two and three years old that were quite heavily infested and there was not an aphid to be seen on the newly set trees. With trees set out later in the winter which are just now trying to put out buds the case is very different. In many cases these buds are pounced upon by the aphids before they are a quarter of an inch long, and the chances for the tree to put out any new growth at all are very slim unless it received help from the grower. The observations of this spring, therefore, would seem to indicate, that trees put out under aphid conditions will suffer less damage if the trees are set in December or early in January. Of course, other factors, such as the danger from frost, must be considered as well as the probability of damage from aphids.

Observations made over most of the citrus belt during the past winter showed that groves in which there was no new growth during December and January got by with the February growth very much better than groves in which there was more or less new growth during December and January. The reason for this is, of course, evident. The aphids were starved out in those groves in which there was no new growth in the early part of the winter. This was true of the entire satsuma belt from Gainesville north. This strongly suggests that from the aphid standpoint the grower should do everything consistent with good grove

practice to throw his trees, particularly the young ones, into a complete dormancy as is possible during the early part of the winter. The most important factor in keeping these trees dormant during the past December and January was undoubtedly the drought from the middle of October to the middle of December. Of course, the grower cannot control the rainfall, but he can, to a certain extent, control the soil moisture by cultural methods. Groves which received heavy applications of ammonia in the late fall also showed more aphid damage during January and February due to the same cause, namely the stimulation of growth during the early part of the winter.

It would probably be an excellent practice (I believe this was first advocated by Mr. Yothers) if the grower would go through his groves during the early part of the winter and break off and destroy those occasional sporadic shoots that come out on young trees, including, of course, water sprouts on the older trees.

On the other hand it is highly desirable to stimulate growth in the spring as soon as serious danger of frost injury is over, the idea being to get as large a percentage of new growth as possible out on the trees before the aphids have time to become numerous.*

It is undoubtedly the tendency in old seedling trees toward alternate periods of dormancy and active growth which is responsible for the very small amount of damage they suffer from the aphids. They are completely dormant in the winter, except for an occasional water sprout, and when growth does come in spring it comes in a rush all over the trees and the aphids do not have time to colonize it before it hardens up.

One thing is certain. The time to begin to fight aphids is in the winter, when the aphids are present only in spots and very few are winged. Go through your grove and inspect it, particularly the young trees, once a week all winter long, beginning at least in December and continuing through January, and exterminate all colonies of aphids found. As the growth becomes more general in February the grove should be covered twice a week, dipping and spot dusting every colony of aphids seen. The time to fight aphids in a grove is when there are few rather than when the infestation is general. Groves, under the speaker's close observation, where this was done, and done thoroughly, last winter, have gotten by with comparatively little aphis injury this spring, provided they were reasonably well isolated. Furthermore, aphids do the most damage when the growth is just starting.

If in spite of the grower's efforts, infestation becomes general in the spring, then he can resort to some of the other methods recommended, such as spraying or fumigation, or to power dusting on the large trees. Probably he will be justified in delaying the power dusting until severe damage is anticipated. By waiting a little while he may be able to save one dusting. It is probable that one or two dustings are all that will be necessary on large bearing trees, with the exception of trees

*It is probable that tangerines suffer more from the aphids, not because the aphids are particularly fond of the tangerines, but because they put out later when the aphids are more abundant.

in low-lying hammocks where growth is more or less continuous, and in the case of tangerines. Tangerines are going to demand more energetic measures than round oranges. On the other hand, the grower can afford to take more expensive measures with his tangerines on account of the price he gets for them.

Practically all of the aphids which spread to large growing trees during the past season came from nearby young trees, and those growers who fought the aphids persistently on the young trees early in the season suffered much less damage on their old trees than growers who neglected their young trees.

Notes on the Life History of the Citrus Aphid

A. H. Beyer, Experiment Station, Gainesville

In our studies of this insect it has been found that weather conditions have a wide influence on the length of life and the mortality. During the warm, dry weather there is a much greater abundance of young, than during cool, wet weather.

There are two types of females which reproduce, the winged form or alate viviparous female, and the wingless or apterous viviparous female. Thus far production has been found to range from 8 to 61 individuals per female. The birth rate was highest during the early part of the life of the female, and the most young were produced in the morning hours. The females have been found to produce generation after generation.

The young have five stages or instars and four molting periods. These stages range from twenty to thirty-six hours. The range of life of the nymph is from five to eleven days. The period of birth is on an average about two and a half minutes, and the period of molting, or shedding of the skin is about ten minutes.

The females give birth to living young. The citrus aphis passes the winter in the adult or nymph stage and under warm, favorable weather conditions continues to breed through the winter. However, eggs have been found by Mr. Cole of the U. S. Bureau of Entomology on Spirea during the winter. The dispersion, or spread of the species is due to the winged adults, their flight being assisted by wind.

HOST PLANTS

In the field citrus has been the most commonly infested plant, particularly certain varieties of the mandarin family. The seriousness of infestation occurring on different varieties is shown in the following order: tangerine, pineapple and Valencia orange, and grapefruit.

In the field this species was also found on loquat, wild plum, sand pear, cudweed, fireweed and spiraea, and in the laboratory we have been successful in breeding it on night-shade, Jerusalem oak, milkweed, dogfennel, peppers and lettuce. Our most successful experiments in the laboratory, however, have been conducted on Spiraea Van Houttei, commonly known as Bridal Wreath.

CHARACTER OF ATTACK

The attack of this aphid is unlike that of any heretofore found on citrus. It not only attacks the young, tender, succulent growth, by sucking the sap through its proboscis, but it also feeds on the blossoms, calyx, shoots, watersprouts, and young fruit. The method of its attack on the foliage is also characteristic in that it shows a tendency to attack the mid-rib and its branches, consequently a few individuals soon cut off the source of food

supply of the leaf, causing it to immediately curl at the point of attack, and become crinkled and somewhat like a corkscrew in appearance. Cross sections of these leaves show many of the cells to be broken down.

The injury to the blossoms causes a large percentage of them to fall, while a double injury is inflicted on the fruit. In the first place, the rind, where it is punctured by the insect, develops little raised places, or knobs, which cause it to lose the smoothness of healthy, uninjured fruit. Also, when punctured near the stem end, much of the fruit falls even several weeks after the infestation.

Preliminary Report on Insecticides for Controlling the Citrus Aphid (Aphis Spiraecola Patch)

W. W. Yothers and O. C. McBride, Bureau of Entomology, Orlando, Florida

During 1924 and spring of 1925 the citrus aphis has caused immense damage to the citrus trees of Florida. Every effort has been made to study the biology and control of this new pest. This paper deals only with one phase of the control measures, namely, the contact sprays. The biology, enemies and control with dusts will be discussed by other entomologists present at this meeting.

NICOTINE SULPHATE

Nicotine sulphate was used at the recommended strength, one part of nicotine sulphate to 800 parts of water. This strength was used with both six and eight pounds of soap to each 100 gallons of spray. The Soap-Nicotine combinations were equal or superior to any of the contact insecticides used in all the experimental work. No difference was observed in the effectiveness where the different quantities of soap were used. Observations made on the thoroughness of spraying and per cent kill indicated that nicotine sulphate and nicotine combinations kill a small per cent of the aphids that were not hit directly by the spray. This would indicate that nicotine sulphate acts as a fumigant as well as a contact insecticide. There are a number of experiments showing that nicotine sulphate is a very effective fumigant against aphids under confined conditions. Such experiments were carried out under control conditions, where air currents, sun light and temperature were not influencing factors. However, there are not experimental figures to show that the volatility of nicotine sulphate is sufficiently fast to act as a fumigant under field conditions.

A few preliminary tests were made in the groves to determine the fumigating value of nicotine sulphate under field conditions. The leaves were sprayed with nicotine sulphate (1-800) and a number of aphids in small net cages were placed among the sprayed leaves. Some of the cages were in contact with the sprayed leaves, while others were varied up to a distance of four inches. Tests were made in both the direct sunlight and in the shade. Aphids that were one inch or more distant were not affected by the nicotine. Those in the direct sunlight gave ten to fifteen per cent kill, while those in the shade gave one to four and one-half per cent kill.

The hot sunshine increased the efficiency, due probably to an increase in the rate of evaporation of the nicotine from the foliage. This explains why better results were secured with nicotine after the leaves had curled than with other contact sprays. It is quite possible that the cupped or curled leaves may serve some-

what as a reservoir within which the nicotine fumes may accumulate in concentrations sufficient to kill some of the aphids that were not hit by the spray. Not the slightest injury to the blooms, young fruit or tender growth followed its use.

FIVE PER CENT EXTRACT OF DERRIS

This is an extract of the root of *Derris elliptica* and has been used to kill aphids in England for more than ten years. Dip tests using 1 part to 1000 and 1 part to 500 gave practically a perfect mortality. When used in spraying at 1 to 1000, 1 to 800 and 1 to 500 satisfactory results were obtained with each dilution. The mortality was nearly as good as that obtained with nicotine sulphate. It has also been used by several citrus growers with entirely satisfactory results.

The actual toxicity curve for the Derris is very close to that of nicotine sulphate but every aphid must be thoroughly wetted with the spray before death occurs. Nicotine sulphate has some fumigating power that adds to its effectiveness while Derris does not have this property. Preliminary laboratory and field experiments gave four to fifteen per cent kill by nicotine sulphate fumes while Derris under the same conditions gave less than 0.6 per cent kill. Thoroughness is essential for a satisfactory control of the citrus aphis. Not the slightest injury to the bloom, young fruit or tender foliage followed its use.

CAUSTIC POTASH FISH OIL SOAP

Soap has been used for killing other aphids for many years and it was only reasonable to suppose that if used strong enough, it would also kill the citrus aphid. It is convenient, low in cost, easily and safely applied by the inexperienced operator. The soap used in the experiments was very low in actual soap content, containing 69.4 per cent water and 30.6 per cent non-volatile materials. No attempt was made to determine the actual soap content but no doubt it is less than 30.6 per cent. The article was thin and poured readily.

The results obtained with this insectide varied considerably due somewhat to imperfect application, concentration of the soap, and the influence of certain solvents in the soap on its hydrolysis. Eight pounds to 100 gallons killed only a few insects, perhaps not more than twenty-five or thirty per cent. When used sixteen pounds to 100 gallons of water, every aphid hit was killed and no difference could be detected in the results obtained from this soap solution than when 8 pounds of soap to 200 gallons, combined with nicotine sulphate 1-800 was used. The spraying was very thorough in this instance. Spraying with 16 pounds to 100 gallons of water by another crew gave inferior results. No doubt 8 pounds to 50 gallons of water will kill all aphids hit by the spray but this evidently has no fumigating properties. No injury followed its use either to the bloom, young fruit or the tender foliage. Caustic fish oil soap is a safe and dependable insecticide if it is thoroughly applied.

LUBRICATING OIL EMULSIONS.

Owing to the effectiveness of these oils in killing white flies and scale insects and

to their comparative inexpensiveness, every effort was made to determine their effectiveness on the citrus aphid. Preliminary tests made May 1924 by dipping branches heavily infested with aphids in solutions containing both ½ of 1% of oil, and 1% indicated that practically all aphids were killed. The remarkable fact, however, was that always living aphids survived and there appeared to be as many surviving aphids in the tests with 1% as with those with ½%. It was thought that these tests were of sufficient importance to indicate that the use of a spraying mixture containing 1% of oil would be satisfactory. Subsequent spraying experiments undoubtedly showed that this dilution only killed those aphids that received a heavy stream of spray under considerable pressure. At 1 per cent of oil these sprays are only partially satisfactory. Used at 1-100 or 2-3 of 1 per cent the killing was not satisfactory at all. When used at 2 per cent the killing was satisfactory, but the defoliation in the spring was greater than good orchard practice would justify.

The injury from using 1-2 to 1 per cent of oil in the spray material resulting to oranges and grapefruit was of little or no importance. It was considered unsafe to use two applications at short intervals. The citrus fruits of the mandarine family appear to be much more sensitive to oil sprays than the round orange and grapefruit. There was no injury from the dip tests during 1924 either where ½ per cent or 1 per cent was used.

* See table

On March 5, some Temple trees were sprayed using 2-3 of 1 per cent of oil or 1 to 100 of emulsion. Two different grades of oil were used in the experiment, one medium and one heavy. Considerable defoliation on the limbs on the tops of trees took place. A tuft of leaves on the ends of the branches was left while the branches were bare for a foot or more towards the ground. A second spraying with the same material on the same trees did not appear to increase the damage at all. It has been noticed by many citrus growers that excessive defoliation takes place on tangerines and Temples when sprayed at the time of the year when the trees are just beginning to put forth a new flush. As a matter of common knowledge, it has been usually considered entirely too hazardous to use oil emulsion stronger than 1-2 per cent on citrus trees during the blooming period or during the flushing period in the spring.

OIL EMULSION PLUS NICOTINE SULPHATE

The above combination was very effective in killing aphids when used at 2-3 per cent oil or 1-100 and also 1 per cent of oil combined with nicotine sulphate 1-800. The dilution 2-3 per cent plus nicotine sulphate caused the same amount of defoliation on Temple trees in March as where only the oil was used. The dilution 1 per cent plus nicotine sulphate caused no injury to seedling trees with tender flush. This is a good combination where the control of white flies, scale insects, and aphids is sought.

OIL EMULSION PLUS EXTRACT OF DERRIS

Experiments conducted with this combination indicate that the two sprays are

compatible. The only dilution used was 1 per cent oil combined with 5 per cent extract of Derris 1-800. This gave a most satisfactory kill of aphids and caused no injury to the tender growth of seedling trees.

SOAP PLUS NICOTINE SULPHATE

This combination was discussed under nicotine sulphate since this material is seldom if ever used without soap as a spreader.

BORDEAUX OIL EMULSION

Since spraying for the prevention of citrus diseases is usually done at the same time the citrus aphid is present in the greatest abundance, it is very important that sprays used to prevent the diseases also control the aphids. The experiments made with the Bordeaux oil emulsion were not extensive enough to determine finally just what results could be expected in killing aphids. It is reasonably certain, however, that oil emulsion retains its insecticidal properties and the combination will kill aphids just as effectively as does the same dilution of oil when used separately. The results of experiments indicate that such is the case. In other words the oil emulsions at one-half and one per cent of oil proved only partially effective. The addition of Nicotine Sulphate 1 to 800 would make the combination effective since the three sprays are entirely compatible. The addition of five per cent extract of Derris 1 to 600 may also be of value but as yet we have not tested the combination.

ADDITIONAL FIELD TESTS

The results obtained from the spraying of a grove with several insecticides will be of value in determining the relative merits of the various insecticides used. The spraying was done April 13th and examination was made April 17th, 1925. It is very difficult to secure accurate toxicity figures for the citrus aphid under field conditions. Two sources of errors are sure to occur in securing such figures: (1) the winged form will move in on the sprayed trees and many of the small forms drop off the tree after spraying; (2) it is very difficult to secure a representative sample for the counts. Efforts were made to eliminate this source of error as far as it was practicable. When the trees were sprayed a part of the infested branches were enclosed in a fine bobinet bag, which prevented wing forms moving in and other dropping off. For the second source of error mentioned, the error was reduced to a minimum by picking twigs at random from four sides of the trees and from five trees in each plot. Counts were made 48 hours after spraying and results given in table below.

SUMMARY OF THE TOXICITY OF SEVERAL INSECTICIDES AGAINST THE CITRUS APHIS

	Number Aphids Counted	Per cent Kill
Nicotine Sulphate 1-800 2 lbs. to 50 gals.	1392	95.6
5% Extract of Derris 1-800 and Oil 1%	5108	94.3
5% Extract of Derris 1-500	1626	84.2
Oil of Emulsion 2%	1705	81.6
5% Extract of Derris 1-800	1703	81.6
5% Extract of Derris 1-1000	2051	78.7
Oil Emulsion 1%	2524	70.9
5% Extract of Derris 1-1200	2624	66.5
Soap 8 lbs. to 50 gals.	1361	18.9

Nicotine sulphate plus soap gave the highest per cent control. No doubt this

spray will prove the most effective for the average grower, especially after the leaves have been curled by the aphids. A combination of two contact insecticides, (5 per cent extract of Derris plus oil emulsion) was about as effective as the nicotine; 5 per cent extract of Derris in dilutions of 1-500, 1-800 and 1-1000 gave very good kill. This spray gives promise of being a very good spray for the citrus aphis.

Oil emulsion as usual was very effective when thoroughly applied.

The results given in this series of sprays were made as near that of commercial spraying as possible. A careful check on the thoroughness of spraying showed that 14.8 per cent of the foliage was missed in spraying.

THOROUGHNESS

The importance of applying an insecticide in a most thorough manner has been emphasized in spraying for the control of citrus insects for many years. Even though such has been the case the ordinary spraying at present is not done with any marked degree of thoroughness. Although thoroughness is an important factor in spraying for the control of scale insects and white flies, it is of much vaster importance in spraying for the control of the citrus aphid. In controlling the aphid on citrus trees a much greater mortality must be obtained than is necessary in killing scale insects and white flies, if the results are to be of commercial value. This more nearly perfect mortality is necessary owing to the extraordinary powers of reproduction possessed by the aphids. Several of the insecticides mentioned in this paper will kill such aphids as are hit by the spraying, but will not kill any aphids unless the insecticide actually comes in contact with the insect. Under such circumstances these sprays should be applied with great care and most thoroughly. If nicotine sulphate is used some of the aphids will be killed which are not actually hit by the sprays. This is due to the fumigation value of the insecticide. Even under such conditions, every effort should be put forth to apply the material in a thorough manner.

NUMBER OF APPLICATIONS

The citrus growers generally realize that it is impractical and inadvisable to follow any spraying scheme to completely control this aphid. The expense would be prohibitive. The only end which should be sought is the protection of the new growth and blooms for a sufficient period of time to enable it to harden, so that the aphids will not be able to feed upon it, or so that the blooms will develop and set fruit. It is regretable that so little is known as to the length of time required for citrus trees to mature a flush of growth, or for blooms to appear and set fruit. More definite information on these points is being sought and no doubt when this is obtained more definite recommendations for the control of the aphid can be given. The studies of the life history of the aphid shows that its life cycle is less than five days. If we take this into consideration it is probable that two spraying at intervals of about six or seven days would be sufficient to protect the new growth and blooms, until they become so that the aphids would not feed upon them.

The Control of the Citrus Aphid by Its Natural Enemies

F. R. Cole, Assistant Entomologist, Fruit Insect Investigations, U. S. Bureau of Entomology

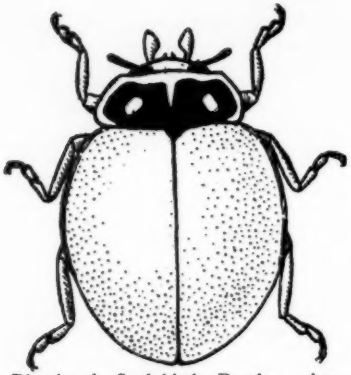
Nature usually maintains a balance among species, but some are much better fitted to compete for a living than others. There is an interlocking and over-lapping of the myriad forms of animal and plant life. Insects would soon overrun the earth if allowed to increase unchecked, but they have many enemies, some of the most important of which are their fellow insects.

Now and then a species breaks through the barrier of its control and spreads like fire. Abundance of food and favorable weather in Florida during recent years have given the citrus aphid an opportunity to increase to a point where its usual enemies have been unable to cope with it. This year the aphid reached new territory and naturally had less to check it, since its enemies are slow to increase and in normal years are not present in large numbers. Parasitism often runs in cycles; that is, an outbreak of some insect occurs and parasites gradually increase until they check it, then the parasites grow short of food and decline in numbers, whereupon the insects increase again, and so on, over a period of years.

The writer began work on the enemies of the citrus aphid, *Aphis spiraecola,* in July, 1924. There are certain species of insects known to prey upon aphids in nearly all parts of the country and a few of these were found at work in the vicinity of Orlando last year. These insects which depend on aphids for their food are now on the increase, and since the publication of a preliminary report last winter, some new beneficial species have been observed. Some of these aphid enemies are abundant in the spring whereas others do not appear until early summer. Insects are divided into classes and in discussing the enemies of the citrus aphid each will be under the group heading to which it belongs.

GREEN LACEWING FLIES (NEUROPTERA)

The pale green insect with four large filmy wings, known as the green lacewing fly is not a real factor in the control of the citrus aphid. It was unimportant last year and up to the present (April, 1925) is still scarce. The small white eggs of this insect are found on the ends of long stalks, standing erect on the surface of the leaves. The larvae of some species are commonly known as "trash bugs" from their habit of accumulating aphid skins, shells of scale insects, etc., which they carry around with them. The value of these insects is lessened by the



Blood-red Ladybird Beetle. Actual length about 3-16 of an inch.

fact that they appear to eat the early stages of ladybird beetles. They in turn are preyed upon by certain internal parasites which keep down their numbers.

There is a brown lacewing fly which occasionally feeds on aphids and is of greater value than the green lacewing. The adult sometimes eats 40 or 50 aphids in a day.

LADYBIRD BEETLES.

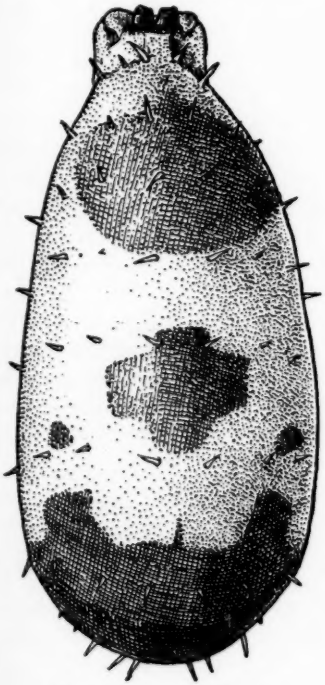
From the beginning of this year's season the blood-red ladybird beetle (*Cycloneda sanguinea*) has been by far the most abundant of the beetles preying on the citrus aphid; in fact, it was the only one found in the vicinity of Orlando when the infestation was first apparent. The adults of this species appear to eat fewer aphids than the voracious larvae, but recent tests have shown that they may eat more. They are quick-moving and devour as many as 100 aphids in a day, according to some observers. This species is now being studied. The larva of the blood-red beetle is black, with yellow or orange spots. The pupa is yellow, marked with black or brown, and is usually fastened on the surface of a leaf, often some distance away from a colony of aphids. Just now this particular beetle is the most important enemy of the aphid.

Two other ladybird beetles are now present around the aphid colonies, the Eyed ladybird beetles (*Olla oculata*) which was one of the most abundant of the predaceous enemies last summer, and the twice stabbed ladybird beetle, (*Chilocorus bivulnerus*). These beetles are alike in general appearance, both being almost wholly black in color, the first mentioned species a little larger, with a yellow margin on the front end and with larger and paler red spots. The Eyed ladybird beetle is evidently the more valuable of the two species. The larvae of the twice-stabbed ladybird are not aphid feeders under normal conditions, but crawl over the trunks and limbs of trees and feed on scale insects. The writer has

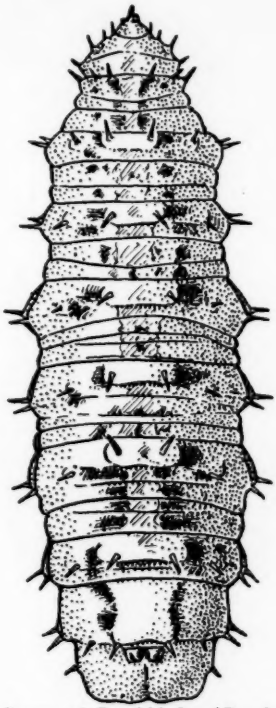
Convergent Ladybird Beetle. Actual length about 4-16 of an inch

never observed them on leaves where the aphids were feeding. The adult beetles, however, eat many aphids.

The Convergent ladybird beetle, (*Hippodamia convergens*), was not uncommon last summer but no specimens had been taken by the writer up to April of this year. The tiny Scymnus beetle is also very scarce this season. The larva of this species is small and darkly colored, covered with long, white, waxy filaments. The larva usually grabs the aphid by one leg and sucks the blood out through it. There are probably several species of Scymnus in Florida. At least two other ladybird beetles are known to eat aphids,



Pupa of *Baccha clavata*

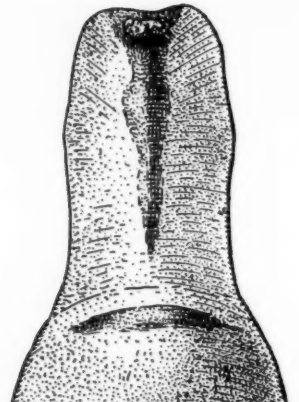


Larva of Syrphid fly, (*Baccha clavata*) Actual length about 6-16 of an inch.

but thus far they are very scarce and little is known of them.

TWO-WINGED FLIES (DIPTERA)

Last summer two syrphid flies were observed preying on the aphids in the vicinity of Orlando; these flies have been called the four-spotted aphis fly (*Baccha clavata*) and the dusky-winged aphis fly (*Baccha lugens*). Hubbard found these flies in Florida many years ago and described and illustrated them in 1885. The first species was of some value last summer but is rare this year, perhaps because



Pupa of *Baccha lugens*

of the earliness of the season; the second species is usually quite rare. The larvae and pupae of the two species are quite distinct. Both of these flies are preyed upon by tiny parasites and their efficiency is thus decreased.

The larvae of all syrphid flies are slow-moving and blind. The small white eggs from which they hatch are deposited by the fly in the aphid colony and if all goes well there is food close at hand for the newly hatched maggot. The larva "spears" an aphid with its pointed, groping head end which is furnished with tiny grappling hooks; it then sucks the aphid dry, usually holding it aloft. These larvae eat perhaps thirty aphids per day when mature, possibly more when the plant lice are plentiful. In a densely populated colony these maggots lose little time, spearing one after another and growing rapidly; they are usually in the larval period for a week or more, but can be literally starved into pupation in less time. This provision of nature enables them to bridge over a scarcity of food and live to produce another generation.

At the beginning of the aphis outbreak in 1925 another syrphid fly made its appearance; this has been called the American Syrphus-fly (*Syrphus americanus*) and it is found in all parts of the United States, preying on many species of aphids and usually attaining greatest abundance in midsummer. It is now the principal fly enemy of the citrus aphid in the groves which have been inspected by the writer, but it is far from abundant.

Another species of syrphid fly occasionally found among aphids might be called the oblique-marked Syrphid (*Allograpta obliqua*). It is widespread, being a species of some importance in California, but it is quite rare in Florida. The citrus aphid is evidently not its usual food since only two larvae have been taken in colonies of these aphids and the flies have been collected on numerous occasions. These flies may increase in numbers, however, before the summer is over.

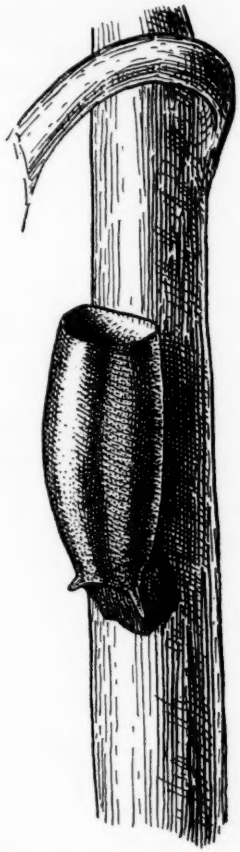
One other fly, *Leucopis americana*, of quite a different group, was of some importance in the control of aphids last year. This insect was termed by Hubbard the Pruinose aphis-fly. It is a tiny insect, silvery gray in color, and resembles a miniature house fly in its general appearance. So far this year this little fly has been conspicuous by its absence, but

it is probably a summer and autumn form. Last year it did good work in cleaning up the aphids on spiraea, the native host plant.

WASP PARASITES

Many aphids are held in check from year to year by tiny wasps that sting them and put an egg inside the body. This microscopic egg hatches into a minute grub which eats out the interior of its host, finally reaching some vital organ and killing it. When it is parasitized the aphid becomes swollen and pale brown or yellowish in color. The parasite fastens the empty aphid body to the surface of a leaf with a secretion which dries to a silk-like fabric. When the adult stage is reached the wasp cuts a circular door in the abdomen of the aphid and emerges as a four winged insect. It is then ready to look for aphids to sting. The life history is a short one and one wasp stings many aphids, so when once established these parasites are of great importance.

The melon aphid is controlled by the same parasite that is now working on the citrus aphid. Unfortunately, in 1924 and early this season this new aphid did not appear to be a natural host and a large percentage of the wasp grubs were unable to complete their development. At present we do not know the reason for this. Possibly the grub does not have suitable or sufficient food, or it may be that it kills the aphid before it can complete its own development and perishes in the decaying tissues of its host. Mr. W. W. Yothers of the Orlando station, dissected out many of these parasite larvae early last summer, but it was not until late in the fall that any of the wasps were reared. In February a few more of these interal parasites were reared at Orlando, and they have been gradually increasing in numbers on the laboratory grounds. Many colonies of aphids now show about fifty per cent successful parasitism.

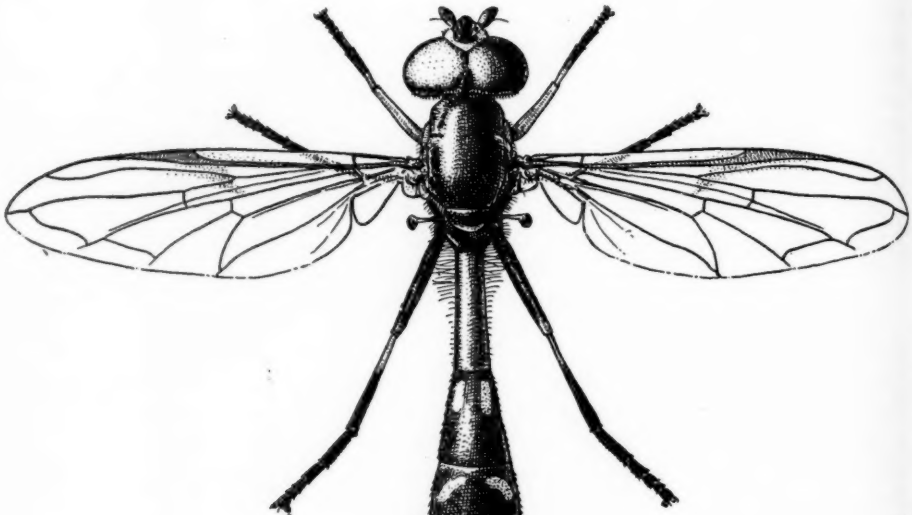


Empty pupal case of *Leucopis americana*, showing two projections on the posterior end, also possessed by the larva.

It has been pointed out by Professor

Watson that this aphid may prove to be a death trap for the parasite because of the fact that the larvae of so many parasites die within the host. This seemed quite possible last year and at the beginning of this season but it now appears that the parasite is rapidly adapting itself to new conditions and there is some hope that it may be able to check this new pest of citrus.

In conclusion it may be stated that no mention has been made of fungus or bacterial diseases among the aphids, because that phase of the aphid control is being studied by other workers in the state and will be reported upon by them.



The adult, or fly stage, of *Baccha clavata*, one of the commonest and most beneficial of the insects preying on aphids.

Report on General Aphis Situation

By Wilmon Newell, Gainesville

Reports were received by wire on Monday of this week, the 6th instant, from eighteen county agents and Plant Board inspectors distributed over the Florida citrus belt and these reports as to the present situation are here summarized:

WEST FLORIDA

No damage from the aphis is reported in extreme north or west Florida. Scattered infestations, however, occur.

CENTRAL FLORIDA

Seminole County. Aphis more abundant than a month ago. Parasites present but no natural control evident.

Orange County. Infestation has increased during the past month and during the past week has apparently reached its peak on round oranges and is heavily infesting nursery stock and tangerines. Natural enemies increasing but not controlling the pest.

Lake County. Considerable increase of infestation over one month ago and about the same as one week ago. Growth maturing on round oranges and damage decreasing. Damage increasing on tangerines. Insect much more abundant than last year and grapefruit being affected. Natural enemies increasing and slight amount of control from this source evident.

Osceola County. Heavy increase in aphids during past month but peak of infestation has apparently been reached. Natural enemies making little headway.

Polk County. Aphis increasing rapidly during the past month and during the past week. Natural enemies increasing but not effecting perceptible control.

Hardee County. Aphis damage much less than a week ago. A very marked control of the insect by diseases is evident.

Pasco County. In many groves conditions better than one week ago but infestation on tangerines serious. Situation at large worse than a month ago. Natural control in a few groves is evident.

WEST COAST

Hillsboro County. Aphis apparently decreasing, due to lack of new growth except in the case of tangerines. Parasites and diseases exercising control to a moderate degree.

Manatee County. Maximum infestation reached in some groves and all new growth destroyed. Grapefruit becoming heavily infested. Natural enemies present but exerting little control.

Lee County. Steady increase of aphids during past month but little damage to present fruit crop. Little evidence of control by parasites or diseases.

EAST COAST

Volusia County. Aphis increasing, just beginning work on tangerines. Very few natural enemies.

Brevard County. Serious infestation not experienced. Aphis apparently decreasing and natural enemies increasing.

St. Lucie County. Aphis severe only in spots; has apparently passed peak of season's damage. The aphid decreasing both because of natural enemies and artificial methods of control.

Palm Beach County. Infestation generally light, with considerable natural control in evidence.

Broward County. Aphis more abundant than one week ago. Some natural control evident, at Davie 90 per cent control being secured by dusting.

Dade County. Heaviest infestation in southern part of the county, insect being held in check by spot dusting. No natural control evident.

Observations on Citrus Aphis Control at Davie, Florida

Arthur C. Brown, State Plant Board, Gainesville

The State Plant Board started dusting citrus trees in the Davie section last August in an effort to control the citrus aphis. The particular reason for this dusting was to prevent the aphis from curling the leaves. Since May, 1922, the State Plant Board has had a crew of men inspecting the groves around Davie for citrus canker. It is very evident that the inspection of a citrus tree with the leaves badly curled by aphis would be almost impossible. For this reason an effort was made to keep down the aphis to such a small percentage that the leaves would not be curled and a proper inspection of the trees could be made.

Work was started last August. The material used is the standard 3 per cent. nicotine sulphate and lime combination. The material is made up on the ground at Davie and is used as rapidly as it is mixed. A barrel mixer was made which can be easily revolved by means of a hand crank. In the barrel are placed large stones to pulverize the lime and assist in thoroughly mixing the dust. The dust is poured from the barrel through a strainer into a large box. It is immediately packed into 50-pound lard cans. These cans are convenient to handle and the top fits close enough to prevent any loss of strength of material. In addition, if the can is left out in the rain there is not much possibility of water getting into the dust mixture.

The schedule calls for a dusting once every seven days. At Davie, in the Everglades, the trees are putting out new growth almost continuously; in fact, there are from ten to twelve flushes of growth per year. This schedule is followed out at times. At other times, on account of trouble with the engine and weather conditions, the time is extended but the groves have been dusted at least once every ten days since early in January. The work was started early in August and was continued regularly up until the latter part of February. At that time the excessive rains made it impossible to get into the groves with power dusters and the work was discontinued. Fortunately, however, about that time the attacks of the aphis had diminished somewhat. From about the first of November until early in January the only dusting done was by means of hand dusters. In addition, all twigs showing curling of the leaves were clipped off by the inspectors and dropped into a bucket of kerosene. This, together with the spot dusting, kept the infestation down to a very small degree until about the first of the year. At that time the aphis began to appear in many of the groves in such numbers that it was deem-

ed advisable to resume dusting with the power duster. Since that time the groves have been dusted regularly at intervals of from seven to ten days. Accurate records have been kept of both the individual groves and of the total week's work; that is, a record was kept of the time consumed in dusting a certain grove, the number of trees in the grove, the size of the trees and the number of pounds of nicotine sulphate used in each grove. In addition, a weekly record was kept showing the total number of grove trees dusted, total number of horse-hours and man-hours, and the total amount of nicotine dust used. The citrus plantings at Davie consist of 4,000 trees. During the period from February 16 to March 21 a total of 23,096 trees were dusted. The total cost, including nicotine sulphate, lime, cost of mixing the material, team hire and labor hire was $540.00. The cost per tree per dusting was 2-1-3c. These trees range in size from a height of five feet with a spread of five feet to large trees fifteen feet high and with a spread of about fifteen feet.

A record was kept of a few groves which were dusted with a hand duster. The cost of *hand dusting* is higher than that of power dusting. In one grove of twenty-five trees, 6x6 feet, the cost per tree was 5.1c. In a grove of fifty-two bearing trees, 12x12 feet, the cost was 4c. In a grove of twenty-five bearing trees, 15x15 feet, the cost was 7c per tree.

We feel that commercial control has been secured in the Davie groves. Early last fall one grove had new growth badly curled before the dusters arrived. This grove has been dusted at weekly intervals since then, with the exception of the intermission mentioned above between November 1 and January 1. At the present time the trees present a peculiar appearance. The leaves curled by the aphis last fall are still very much in evidence. Growing out of the tip of every one of the branches is new growth from one to three feet long without a curled leaf on a single branch. In other words, even though the old growth was heavily infested by the aphis and the leaves very badly curled, repeated dustings of these trees have prevented the subsequent growth from curling. An idea of the degree of control secured at Davie may be obtained from the following comment.

A report was turned in on February 17 on fifty-two trees with the following notation: "Heavy dusting, badly infested." The man in charge of the work immediately went out to see these trees to get an idea of the situation. After looking over about twenty-five of the trees, several trees were finally located with from two to five colonies of aphis present. These aphids had not been there long enough to cause any amount of curling, yet in the opinion of the man dusting that grove these trees were considered as being badly infested.

The duster used is the regulation Niagara power duster. The material used is a homemade mixture of a 3 per cent. nicotine sulphate and lime combination. The lime cost $20.00 a ton at Ford Lauderdale. The nicotine sulphate, in 500-pound drums, cost $1.10 a pound. One man can very readily mix up 100 pounds of the nicotine sulphate mixture in one hour's time. With the above figures, the mixture

used at Davie, Florida, costs the State Plant Board $9.26 per 100 pounds.

The labor used at Davie is supplied by our own grove inspectors, that is, we use our own inspectors in dusting groves. Day labor is scarce at that place, and it is our contention that if money is to be spent on dusting the trees it should be spent to the very best advantage and only such labor used as can be depended upon to do the work efficiently. It is for this reason that we use our own men and as a result the costs are a little higher than would be the case if cheaper labor were used.

Unfortunately, we have not been able to do any night dusting. The groves in question are located in the muck country and there are deep ditches running all through them. With the high grass in the groves, it is a rather difficult matter to drive through them even in the day time. At night it would be impossible. From eight o'clock in the morning until almost sundown there is a strong wind blowing at Davie. For that matter, the wind is usually also rather strong during the night at that place. As a result the dust is blown above the trees and there is no appreciable amount of kill from the dust drifting through several rows. Under such conditions the only efficient manner of dusting is to apply the dust directly to every tree. In some cases in the heavily infested groves where the trees are very large, both sides of the trees are dusted. We have one report on a grove of 220 trees nine feet high, with a spread of about nine feet. These trees were dusted on both sides and the machine stopped at every tree in order that the tree could be thoroughly dusted. In this grove 200 pounds of nicotine sulphate was used on 220 trees. This is an excessive amount. The following are figures for other groves:

No. trees	Size	No. lbs. of nicotine sulphate	How dusted	Cost per tree
502	15x15	100		2.1c
216	15x15	50		3.0c
543	12x12	95		2.1c
328	15x15	75	Both sides	2.7c
697	9x9	90		1.4c
695		90		1.4c
590	6x6	50		1c
359	6x6	75		2.4c
605	6x6	100		1.8c
152	6x6	40		3.4c
82	6x6	25		3.6c
4569			Average	2.7c

Citrus Aphis Situation

Dr. E. M. Gilbert, Madison, Wis.

I am not an authority on aphis. I have had very little to do with them. We are not much bothered with this pest in Wisconsin, but I am interested in its parasites, and feel I can perhaps add a little information.

So far, nothing has been said of the natural control of the aphis by fungus parasites. We are overlooking one rather important factor, and that is control by fungus parasites.

The control by fungus parasites is nothing that is new. Probably the first work on the control of insects by fungus parasites was that done in South Africa, where they have learned to control a large number of insects by the use of fungus parasites. In this country, probably the most interesting thing in this way is the control of the chinch bug by the use of fungus parasites, found in the soil, one of which was exported from South Africa. Another is the control of the grass-hopper by fungus parasites. We know that the cabbage worm is absolutely controlled by the fungus parasites. In the north we sometimes have control of the June beetle by means of the fungus parasites. Dr. Speare, who lived with you here in Florida, was sent to Hawaii to aid them in the control of the fly which was tending to eliminate pineapples. He presented a fungus that eliminated them. He came here, but has since gone into commercial work now. If he had been allowed to stay here he could have aided a great deal in this situation.

Dr. Berger's method of control of the white fly, is another example of work done by fungus parasites. Two years ago in Wisconsin we were furnished with an aphis under some of the conditions that you have here. Wisconsin ranks highly as a pea state. We canned last year about 60 per cent of all the peas canned in the United States, and as the business is something that lasts only 6 or 8 weeks, it means an immense loss if the crop is a failure. Two years ago our pea fields were badly infested with aphis. There was no chance to spray, and to dust, and it seemed for a while as if the situation was hopeless. The Government sent three or four men to work on it, and our local men worked, starting in last year, to see what they could do. They invented the aphidoser, on the principle of the vacuum cleaner, which was supposed to pull most of the leaves off the plant. It was not entirely successful, but in connection with it appeared rather a peculiar thing. The year before there had been reports of a mold appearing on the aphis. Last year it appeared, and absolutely eliminated the aphis. The crop was a perfect crop. It ranked 105 per cent. or 120 per cent. better than normal. The fungus absolutely controlled the aphis.

We have with us other aphis which are at times attacked by parasites. We have your aphis in Wisconsin, in Michigan and in New York on the apple tree. It is nothing serious with us. We spray for it as soon as it makes its appearance. If, however, it were allowed to run riot it would do just exactly as it does here. You are not the only ones concerned with the aphis on the citrus fruit. California has the aphis, as you have it, and each year you will find that they are warned early in the year to get after the aphis, especially on young, new growth, and they spray, and have it under control.

The question comes up as to what we are doing, and by that I mean, not myself alone, and I would like to say something to you about what others are doing. Last December I was at Washington, at the meeting of the American Association for the advancement of science, and met Dr. O. F. Burger. He spoke of your aphis trouble last year. Knowing that I was to be on a leave of absence, he said: "If you will come down to Florida we will show you the State, and give you a good time." I thought nothing more of it until the 22nd of February, when I got a telegram, asking under what conditions I would come to Florida and help in the aphis work. I wanted to see Florida, so I wired back I would come for my expenses, and spend two months here. I got a telegram later asking me to come on. I am here. I have a number of former coworkers, and some former students here. They have written wonderful tales as to what they do. I wanted to come and see. I wanted to see the 64-foot sprayer used in tomato fields; I wanted to see the tobacco and lots of other things. We don't believe those tales up north. What we are seriously doing, however, in the laboratory at Lake Alfred,—I am having a good time. If any of you want to see me, come down to Lake Alfred any time from 7 A. M. to 9 at night, and you will find us happily engaged with the aphis.

We find that there are three or four types of fungus parasites. We found on the aphid an abundance of green material that we speak of as cladesporium. It appears in most cases as a growth over the aphis. I am willing to say it is a parasite, because I have dissected them dead, and not yet dead, and found this parasite coming out. We thought for a time that they make a nice lead for the control of the aphid.

Next, and most important in the field is the Empusa. This fungus is attaching the aphis in abundance. Materials sent in show at least 50 per cent. kill, and in some regions in the State a much better kill than that. This Empusa lives in the interior of its body, and when it matures, pushes out and produces an immense number of spores each of which are capable of killing a single aphis. The trouble with this fungus, however, is that it does not grow under laboratory conditions.

But if you had some days now, such as I understand you have in June, I am sure there would be no trouble in the control of the aphis, but it needs some warmth and an abundance of moisture.

At Temple Terraces a large acreage of Temple oranges were sprayed or dusted. When the material came into the laboratory they were able to show us 100 per cent. killed by dusting. There had been

a commercial control of the aphis, apparently. However, when we began to examine this material we found there were an abundance of aphis that were dead, but found they had been killed by this Empusa, and not by the dusting. So there again, we had a case of seemingly quite a good control of the aphis by the fungus, when conditions were ideal. The Empusa is not gaining the upper hand, but is gaining considerable control. That is of interest this year to you people, because last year I believe your aphis infestation was about the middle of May. That means that the peak was on some 5 or 6 weeks from now. This year the reports read by Dean Newell and from the Plant Board, seem to indicate that the peak of aphis, development is here at the present time. Probably your insect parasites are gaining control, and on the other hand it means that this Empusa and other forms are acting much earlier this year, and next year it probably means that they will gain another few weeks and your peak may come the first of April. It was the 15th of May last year. We have noticed if certain conditions are abnormal, an increase one time of the insects, and another time we may have an increase of the fungus that control. Now why and how you have an abundance of aphis here is not to be explained by anything that we know at the present time.

We have found recently another form of parasite attacking the aphis, and that is the bacterial form. I am not going to agree with Dr. Cole as to what he said about the parasites attacking the aphis. With a large number of the forms of aphis which came into the laboratory which we thought were parasites, we found another larva present. We thought we could pick out those parasites by insects, and those being caused by some other organism. We feel at the laboratory that we have found another parasite, a bacterial form, which is gaining partial control in some regions. Material sent in from Wauchula showed as much as 50 per cent killed by this new bacterial organism. Thus we have possibly one means of controlling the aphis other than the insecticide fumigation and spraying. It can be cultured so it can be distributed, and it can be distributed so it can be used as a spray, and if this organism will work as we feel it will, it is of some importance.

But we are optimistic, and as I am going to get away in three weeks you will have no chance to come back at me. So at the present time, at least, we are working from early in the morning until late at night, trying to devise a method by which we can culture this bacterium, and we are hoping that we may have something worth while. We have heard and seen a good deal in the papers the last few weeks about the fact that experts are not on the job. That may be true, but we are fiddling with our own experiment—fiddling hard, and if we succeed in getting them to work harmoniously we may give you a real tune.

You have here at this time a rather serious problem, but I don't think it is any more serious than the people have in other regions with the aphis. I want to leave this with you—and that is this, that you ought to ask and demand that some one

be kept on this aphis job, and I hope that before you leave here you will suggest to the State Legislature that they continue their Emergency Appropriation, and see that some one is allowed to co-operate with E. W. Berger and others, and see if they cannot get some practical control of the aphis.

Citrus Aphis

E. W. Berger, State Plant Board, Gainesville

It appears that the preceding speakers have about said it all. However, I have felt myself tempted several times to get up and connect these different papers in the manner of a short summary, which, of course, as Prof. Watson has put it, may be tentative, but perhaps it's the best "tune" that anybody can play on the subject at the present time.

During the winter, take out the sprouts, spot dust or dip if aphids are present, or you may do all three. Later, if the aphids begin to get more abundant, and you cannot keep up with them by the methods indicated, do more dusting or spraying, and eventually (especially during spring) you may have to resort to the use of the power duster or sprayer, especially for the larger trees. We have also observed during the last several weeks, on specimens received in the laboratory at Gainesville, a more frequent occurrence of the little wasp-like parasite infesting these aphids at one place or another. I just recently found a splendid colony of these parasites on the horticultural grounds at Gainesville, and at once colonized them into another colony of aphids. We are hoping, and believe we are correct, that in a few years this little parasite will be the controlling factor in checking the spring development of the aphids. Until that time, growers will have to apply the artificial control measures indicated as well as they can. It also appears as a safe proposition that, if growers will faithfully and energetically control the aphid during each spring (during the years while we are waiting for this parasite to become effective) and carry their trees along up to a certain period each year, to the middle of June last year or May this year, until the natural enemies (fungus or bacterial), so effective during the summer time, can get busy, that the jig is up for the aphids during the rest of the summer. That is the way it worked out last summer, and apparently will work out again this summer, as Dr. Gilbert has indicated, and as specimens being received at Gainesville indicate.

To briefly recur to last year's experiences: I recall that along in late May, 1924, Mr. Yothers wrote me that he had been down to Temple Terraces, and at Valrico, and stated that the aphids were "as thick as the sands on the seashore." It occurred to me that right then was a good opportunity for testing some control experiments that I had in mind, so I went down to Temple Terraces and Valrico, but found that the aphids were practically all gone. I had difficulty in finding half a dozen trees that had sufficient aphids upon them to make it worth while to dust them, so completely had the natural enemies destroyed them at Temple Terraces. Hence it appears to me that

this problem is going to be solved: maybe it is already solved; I don't know. It will largely depend upon the growers—how well they will co-operate in carrying out the suggestions for winter and spring control. Nature, it appears, is going to control it during the summer time.

Again, this point should be kept clearly in mind, that the period of spring growth, blooming and setting of young fruit, is the critical time during which the aphids should be kept strictly under control. Winter and spring control are preparatory to this period.

Member: How is that spore conveyed? How does it propagate?

Dr. Gilbert: On the 23rd of March we put two of these parasitized aphis in a flask, with probably 250 or 300 aphis; the next day 16 of those aphis were dying or dead. The following day all of them were dying or dead, and at that time we started to make efforts to find out how the bacteria are spread in nature, and what we might do to get it in culture for distribution. We found they spread almost entirely under moist conditions. It is necessary to have enough moisture to produce the spores. We found when attacked by bacteria that the aphis became swollen, and emit a drop of fluid. Other aphis walking over this may carry it to other leaves and deposit it at the same time they are depositing the young.

Member: How is it injected into the new victim?

Dr. Gilbert: It is probably by contact.

Mr. Zimmerman: On the 3rd day of March I went over the grove, and we had as many aphis as we ever had last year. On the 4th of March we had a light frost; on the 7th day of March I went over the grove, and the aphis were apparently all dead. We would have to go to 4 or 5 trees before we would even find a live aphid, and about 4, 5 or 6 days later they began to appear again. At the present time we have aphis all over that property. I went over it day before yesterday, and we are getting approximately 50 per cent. to 60 per cent. killed.

Mr. L. B. Skinner: How are you getting it?

Mr. Zimmerman: Apparently by bacteria. The aphis seem to die from the time they are very small, and I have even found some of the winged variety that were turning brown and dying. It is the only thing I have seen have any effect. The first of the week I went to another grove and brought several leaves that were entirely covered with aphis that were normal, and tied them to branches on these infected trees, and the next morning there would be half of them dead. I am at the present time taking leaves from these groves and distributing them among the other groves. I have sprayed several lots to see if I could kill this parasite. I sprayed with Bordeaux and it did not have any effect. I sprayed with nicotine and oil and lime sulphur, and I figured if it was the fungus that was killing the aphis, Bordeaux would probably kill this fungus. One day you can mark a leaf that is covered, and it may begin to curl a little. The next day there will be 40 per cent. to 50 per cent. of them

dead, and the leaf doesn't curl any more. Last year and the year before this grove was entirely covered with aphis, and it was in very bad shape. Whatever this is, it seems to have started, and killed them in very cold weather. They seem to die almost over night, and the caretaker tells me he hasn't done anything.

Mr. Stevens: Mr. Gilbert, can you tell me the name of that bacteria?

Mr. Gilbert: We don't know that we have seen it yet. We are culturing bacteria that we think is the one. We are isolating them and hope to have the organism. One of them is a very strong gas producer, and we feel that is probably the reason why so many of the aphis are swollen.

Mr. Berger: I would like to ask Mr. Stevens how he tried to spread that fungus?

Mr. Stevens: A solution was poured on the aphis, and they were kept in bags from 3 to 8 days.

Dr. Berger: You got no results?

Mr. Stevens: No.

Dr. Berger: I was going to suggest to Mr. Zimmerman that if he wants to carry on an experiment he might collect some of those aphis that seemed to be killed, and stir them up in water, stir up the leaves and everything, and then spray it off. Use a perfectly new sprayer, and do a little spot spraying around.

Mr. Zimmerman: How would one of those hand sprayers do?

Dr. Berger: It's all right.

W. S. Hart: At the convention of this society one year ago, I found much anxiety and apprehension over the prospect of very great injury to the Citrus Interests of this State, resulting from the blighting effect of the new orange aphis and the end thereof no one seemed bold enough to predict.

The trouble is still with us, but the cloud seems not quite so dark as it was a year ago, though a kind newcomer might even yet see cause for discouragement after hearing so much talk about diseases, pests and other drawbacks that must be faced by the fruit grower and thus be induced to pack his grip and hunt for other and apparently more favorable conditions.

Will he find them? After fifty years in Florida—nearly all that time an orange grower, I will say, "I doubt it."

I know this state well. Every state in this union is familiar to me, and going beyond, I know this continent nearly from end to end as well as much of Europe, Asia and Africa, and can say the fruit grower, like nearly every one else in every other line of industry has his troubles everywhere, and in the sections where horticulture and pomology is most highly developed they are as bad as ours, or worse. Take the Hawaiian Islands, for instance, as nearly an ideal abiding place as earth offers to man, and there, where fruits are delicious and in wonderful variety, they have the Mediterranian fruit fly that attacks seventy of them, practically ruining all of these for commercial purposes except the banana, the cocoanut and the pineapple. The latter being shipped only after canning. The Chinese rose beetle is with them also, and there where flowers are so abundant and highly prized roses can be grown only with the greatest care and protection.

I have seen the citrus industry ruined so

many times in Florida, in California, and in other countries that a new trouble does not seriously disturb me any more. Since the eradication of the citrus canker in Florida, I have come to believe that nature, and the splendid men we have within our boundaries and in the Department of Agriculture in Washington, in conjunction or separately, can solve any problem that is likely to present itself.

The first pest of the orange tree that seriously alarmed the Florida grower, to my knowledge, was the purple scale. Back in the late sixties and early seventies it caused some growers to abandon their plantings and put the land to other uses.

Later came other kinds of scale and the mealy bug.

The cottoney cushion brought utter discouragement to many of the California growers and groves were abandoned by many, but the U. S. Agricultural Dept. Scientist in Australia, the native habitate of this scale, hunted its enemies and imported the Vedalia, a small lady bug from there, and within two years all was well again.

The rust mite came next and then Mal de Goma or foot rot arrived from Spain or the Azores and took many of our trees here and there throughout our groves, leaving open spaces to be planted under apprehensions that the new planting would go the way of the old. Blight used us even worse, and is still our most serious problem, but we know now what to do with it.

The freezes of 1894-95 cut to the ground nearly every grove in Florida. Those who had courage put all their energies in to rebuilding their trees on the old roots only to have them cut down again two years later, and again in 1899 worse than ever, and then in 1900 we learned how to protect fruit and trees from cold.

Orange culture was then the largest industry in the State. It was paying a good bank interest on $80,000,000. The prosperity of nearly every other depended largely upon it and it seemed to be wiped out, but without insurance to help.

Without property upon which loans could be secured, with incomes, gone capital not available and all conditions looking gloomy to most of us, many brave spirits struggled on and those who first brought their groves into bearing condition found them more profitable than ever and money seemed the easiest commodity to accumulate and all losses were soon more than compensated for.

The development of greater diversity of crops and industries that soon followed made a like disaster for the future, impossible.

The next trouble, as I recall it, was the White fly which spread over the state bringing dire discouragement and then came citrus canker, the most deadly of all, that succumbed to fire alone, only to be stamped out after it had spread through several counties, and seemed to be past possible control.

We had the right men in the right place, however, and they turned the trick and through it eradication accomplished the greatest thing of its kind ever put over on the earth along this line of effort, and there are few, indeed that can compare with it.

This new aphis may give us trouble and cause expense for a short time but

soon new enemies will develop and new mechanical methods be devised, to overcome and reduce them to minor trouble, to be nearly or quite forgotten, as others too numerous to mention have done in the past.

For 35 years or more I have done no spraying to kill insects prefering to put my trust in what could be accomplished through the enemies and diseases of pests to over come them.

My fruit has always brought top prices, and never failed to show fine profits, which I accept as proof that my methods were not far wrong, which being less expensive then most others, some of which I have also proven successful and satisfactory.

There is an able corps of scientists at our Experiment station and probably the ablest one on earth under the Agricultural Department at Washington, many of whom are constantly at work on the problems of the fruit grower.

There are able, observant, practical men in our own ranks who also give them close attention and study.

With such backing though citrus culture will continue to have its ups and downs, it will also be constantly readjusting its self to new conditions and show good profits to those who use brains and fertilizer liberally in the production and handling of their crops.

So, good friends, my message to you now, as I lay down the good work, because of having passed the "three score and ten" mark, is that the true horticulturist who loves his trees and looks carefully after their welfare himself, the future of citrus culture is, and will be for many years to come, very alluring.

Mr. Widden: I would just like a word or two. I have enjoyed all these papers that have been read here immensely. I am like the old brother here, so you know I have been here a long time. I have met nearly every bug going and coming, and nearly every calamity, difficulty and trouble. If we take it right, we'll come out all right. In '78 I was just a great big boy, nearly grown. These same bugs came along here by the millions that year, and curled everything that would twist. Now I was right on the ground, and I saw it with both eyes. They got off the orange trees as soon as the first growth was hardened. It was this same bug. I have had him up under the glass and looked at him from every angle, and he looks just like the same chap. Maybe he is not, however. As soon as the watermelons were big enough he got right off from the orange trees, and dropped down onto the watermelons. That was what I hated him the worst for. He just romped on everything from one side of the grove to the other, until the June rains hit us, and the hot sun came out, and I know what killed him. When the June rains came, and the hot sun came out he vanished over night, and I never saw the gentleman distressingly and alarmingly near until this year again, but however, he did come back to the upper part of this State in '85, and he just romped on everybody up along the St. Johns. He has just come back to pay us a visit. Just sit steady and take care of your groves, and you will be proud of it.

Town and County Beautification

John R. Van Kleek, Landscape Architect and Town Planner, Boston and St. Petersburg.

I am very much pleased with this opportunity to meet again with the Horticulture Society. When last I met with you it was at Miami. Then I had only been in Florida a year and Florida business meant opportunity to me. I was interested in Florida and Florida development from purely an economic viewpoint. Since then I have become a citizen of the state and Florida development is now a part of my life. The rapid development in these last few years is an old story to us all. What the real Florida of the future is going to be lies with the energy expended by this group of men and like groups of men throughout the state.

When Mr. Floyd honored me by asking me to meet you and discuss with you Town and County Beautification, my first thoughts of the subject were in terms of the adornment of roads and streets and parks with trees and shrubs and flowers, and the preservation of Florida's natural beauty. In my work of town planning my thoughts in these last years have been centered not so much on the adornment of what we have, but serious planning for the future in some of the fundamentals.

I often recall one of my first experiences in town-planning. It was some years ago in Virginia. Myself, with some engineers, were sent into Virginia to survey some 800 acres and build a town. It was one of my duties to consult with the owner and try to work with him and develop along with him their new town. At the first conference, which was at his home in a nearby city, he asked me to walk with him around his estate. We even had not started the survey at this time. He came up to a beautiful bed of lilies of the valley. He stopped and exclaimed, "Here we are. These are all at your disposal. We want to make our town a city of flowers." "Now feel free to use all of these plants in the work." We came along to a huge bed of Iris. He made the same speech. I felt it my duty then to remark, "That is fine, but our town will not be ready in two years for flowers."

The point I am trying to make is that this visionary man saw the finished future but had no idea of the fundamental work to be done before the dressing up process could take place. I believe that is exactly where we stand now. We hear on all sides "Sell the State of Florida to the rest of the world". I believe we ought to first sell the State of Florida to ourselves. We all know and accept the many wonderful things about the state. But how many people really stop to think of what we have now and exactly what the future holds for us? Can any of us

really visualize the future Florida of fifty years hence? Perhaps we cannot exactly see it all, but we can think of some of the things that future holds for us.

We know that certain groups of people throughout the state are giving serious thought to it. The many clubs of beautification are doing great work namely, in cleaning our highways of signs—preservation of the native trees and shrubs and also centered efforts in planting our highways and streets with trees and shrubs.

I hope the time is soon coming when the cattle menace will be no more. Great things have been accomplished in the last year and I know the problem is about solved. I hope one of these days we can take down all of our fences and make Florida one big open park to drive through.

An article in Tuesday's Tampa Tribune copied from the Davenport (Iowa) Democrat, surely summed up some of these efforts. Please let me read it.

"Davenport Democrat: They are not only protecting their people against income and inheritance taxes, down in Florida, but they are proposing a bond issue of $70,000,000 for further building of hard roads.

"Florida is beginning to rival California in the advertisement of her natural advantages not only as a winter resort but as a place of permanent residence. She has a way of making herself so attractive that many who go merely to visit are charmed into remaining — or at least coming back again.

"For instance, in some sections where roads are under construction and the old road borders a row of magnificent oaks and other trees, rather than disturb the beautiful handiwork of nature, in order to widen the highway the authorities have built two-way roads, one on each side of the trees.

"Twenty-one of the sixty-three counties in the state have put into effect regulations prohibiting any sign on public highways except those put up by county or state as traffic guide signs. In seventeen counties County Beautification committees have been organized and these have for their distinct duty the preservation of trees and shrubbery along the highway and prevention of their butchery by public utility corporation linemen. Definite movements have been fostered to set aside 100 ft. right-of-way along the principal highways and to conserve natural growth in this space.

"Under these conditions one does not wonder that motoring in Florida is a joy. It is very different, for instance, from being mud bound as we are in Iowa today unless we have a stretch of paving on which to reach our destination. Imagine auto touring for pleasure, in Iowa in the spring! And yet, that is Iowa's most beautiful season, and the time when we ought to get the greatest thrill out of doors."

All of these efforts are wonderful but I feel that we will get nowhere along these lines. What we need is concentrated thought in planning on the future. What is happening in many of our older cities, not alone in Florida, but throughout the country. They find the streets are too narrow, they have no parking space for automobiles, the railroads are in the wrong place, not sufficient provision has been made for parks and recreation fields. The correction of all these is usually impossible because of the huge task involved.

Here we are in a most opportune place. We are working in the beginning of all things for Florida. We have opportunity to hand down to posterity something worth while.

I think each and every county and town and city in the state should analyze their own situation. In the county the road developments should be planned over a period of years. County commissioners should cease to wind the road around their own lands. Roads should be built to serve both through traffic and county traffic.

Just recently I saw in the papers where an investigation is on in one of our larg-

est counties because the commissioners had expended all the monies appropriated and had not built good roads nor covered the necessary traffic lines. They tried to spread out too much and have failed.

In the towns and cities the problems are more complicated. We enter by both train and automobiles. That is a fundamental thing. Is your town built along a railroad and does the railroad over-shadow everything else by freight cars occupying all the beauty spots in your town? The railroad is certainly a most important thing in the upbuilding and life of a community but there its use ceases. The main real object of a town is a place to live in and the railroad when it serves its transportation problem should be put in its place and kept there.

If your town is a one-sided town with its main street along the railroad track something is wrong and every effort should be expended to change the situation. The railroad has its right of way. Change your auto traffic lines away from the railroad and build your city thusly.

Next is your auto traffic lines. These roads should enter your city devoid of numerous right angled turns—without crossing and recrossing railroads and its entire course through the city should be through a broad highway beautified and well maintained.

The city which solves these problems will have no trouble in attracting the new home seeker.

The remainder of the city should have broad streets and parkways and parks and boulevards. These things won't grow, and when things do grow without control, chaos results. Will you pardon a story on the point?

"Some people up in Georgia were all killed in a railroad wreck. They found themselves in hell—they looked around and saw a great many Georgia and Carolina friends, but none from Florida. They asked the devil and he said he had to keep them behind a big wall or they would have all hell sub-divided."

Here is what we are up against. In new towns where the development is controlled by a group of people all things are possible. Such is the case in the town of Davenport, one of our town-planning jobs in Florida. I don't say we have solved all of the future problems, but we have solved all of the present-day problems I believe and have tried to look into the future.

But outside of these single-headed developments the case as it now stands is hopeless almost. Anything can happen and let the future take care of itself. Where will it all end? What are we facing? When will we have laws to stop miscellaneous sub-dividing in a hit or miss fashion, squeezing the last lot out of the property and forgetting the future.

We have three bills going through this present legislature — the State Forestry Commission, the State Park Bill and an Enabling Act. This Enabling Act to me far exceeds in importance the state inheritance act or any other act that has come up in my knowledge in Florida. This act will allow city and town to zone their cities and have town-planning boards with real authority.

Fifty-eight Chambers of Commerce are

behind the Florida Development Board as Herman Dann himself told me last week, believe it means more to Florida than anything else that could happen This great meeting at Palm Beach voted for it. I believe that if I get this convention to work for this and endorse it, and perhaps convince some individuals to push it through their representative, that I have done something for future great Florida

Experiments in Growing California Grapes in Florida

Paul Hawkins, Eustis

Every state in the early stages of its development (and certainly Florida is yet in this stage) is unfortunately exploited by disciples of Ananias. The resources of the state are "Bucket-Shopped," and it becomes next to impossible to tell the solid gold bricks, from the plated ones.

I am telling you of my experience with grapes, rather then with bananas, avocados, or any other new crop, because in my experience and observation, they have given more promise of scientific development and ultimate commercial success, than any other new crop with which I have experimented.

I regularly experiment with every new crop; that is, every one that has real promise of making good in a commercial way. The limiting factors in this work, being time and money.

I have taken the time to give you this glimpse of the background of my experiments, that I may eliminate from your minds, as much as may be, any suggestion or reason for putting me in the "Get-Rich-From-Grapes-While-You-WAIT" class.

The questions most forward in the minds of those who are in any way interested in grape culture in Florida, are:

I. Can bunch grapes be grown successfully, either commercially or for home use?

II. What varieties are best?

III. What is the quality of fruit?

IV. When do they ripen?

V. What is the market for Florida grown grapes?

The truthful and complete answer to these questions is a pretty thorough ultimate answer to the grape question in Florida.

In what I am about to say I will endeavor to tell you what my experiments in their present state indicate as the answer to these questions. Do not misunderstand me, that I am professing to give you anything like the ultimate answer; for to even approach this will take years of study and experiment.

Question I. "Can bunch grapes be grown successfully, either commercially or for home use?"

The first step in determining the adaptability of any genus of plants to a certain locality, is a study of the indiginous plants of that locality. If no native genus of the plant to be introduced exists, the experiment would seem to me to have a questionable chance of success and should be approached with caution.

Those of you who have tramped or hunted the high-hammocks and piney woods of Northern and Central Florida, even though you were not even interested

in grapes, could not help but notice the wonderful growth made by the native wild grapes: Cinera, Simpsonii, Coriacea and Aestivalis. With their countless hybrids—vines a hundred feet long and three to six inches through at the butt. I believe the best descriptive word for them is profusion, in distribution, growth and fruit.

This is certainly evidence that bunch grapes will grow in Florida, though our native wild vines as they are, have little or no value in so far as quality of fruit goes, and when I speak of our native wild vines, I mean in every case to exclude the Rotundifolia or Muscadine, which has little part in the scheme of viticultural development in Florida.

Measured by the time that has elapsed since the domestication of the grape (at least 5,000 years), it is but "yesterday" that all of the Northern and Eastern part of the United States had no more nor as much of a start in the grape industry, as has Florida today. California and the West Coast were grapeless, except for a few vines at the old Spanish Missions. Since "yesterday" the North and East have domesticated their wild grapes, and have discovered a few accidental hybrids of questionable botanical origin. California, Arizona and New Mexico have imported their thousands of varieties of exotics from the Old World, and many crosses of the two classes have been made which have furnished all parts of the country with new and valuable varieties.

The evidence of this history of the grape in the United States should open a logical train of thought and a definite line of investigation; should demand thorough investigation and study of what relation the native wild grape should have to the future development of the industry.

Past experimentation and study along these lines were carried on with the same general background and for the same specific purpose, as exists for the present and future, i. e., scientific knowledge and profit. Past experimentation and study however, were carried on with special reference to, and in particular, for the then existing grape regions—for their soils, their climates and for the palates of their people. Much of the work that has been done will help the Gulf States in the development of a valuable and stable grape industry; yet I see no reason why Florida can consider the question settled for her, until she has done her own development work.

It is not reasonable to expect that the domestication of the Florida wild grapes will be a repetition of the history of the domestication of the wild grape in the North and elsewhere, yet we have the almost positive assurance that it will enter largely into the final solution of the grape problem in Florida.

Of equal importance to the domestication of the wild grape, is the adaptation here of grapes from other and similar climates and soils. As the results to be obtained from this method are so much quicker and are accompanied by a comparatively small amount of work and study, it has been, and will be, the method most universally adopted. However satisfactory the results thus obtained may seem, they cannot be conclusive.

In the selection of varieties for importation, the same fundamental reasons

should govern, that mark the domestication of the wild grape as an essential part of the development of the grape industry. Those varieties that are most likely to thrive, are those native of similar climates and soils. The grape industry in Florida, as far as it has gone, indicates that this is so, as do the experiments that I have made, both with pure blooded and hybrid American varieties.

The question of adaptability as indicated above, would seem to be of paramount importance. I like not the word "adapted" in connection with the introduced varieites, for it is open to the interpretation and is likely to convey the meaning that, any variety to which this adjective is applied, is a variety that has been adapted to its. new environment, which is not the case with any grape in Florida. Such a process of adaptation would require years of patient work and selection. The outcome of any such attempt would be so questionable and the time required so great, that I doubt that any one will purposely attempt it.

Dr. T. V. Munson in his "Foundations of American Grape Culture" (and he differs only slightly in his classification from other authorities), lists some 28 species and sub-species as growing successfully in various parts of the United States. Of these one is truly an exotic to the American continents, V. Vinifera, or as it is commonly known hereabouts, "California Grape."

The origin, as well as the history of the domestication of this species is obscure. We know only that it is of great antiquity and that it came from somewhere near the shores of the Caspian Sea. Certain it is that in the past this species has spread and has been truly adapted through all of Western Europe, until today it is found in a greater variety of soils and climates than any other single species of cultivated plant.

V. Vinifers of all grape species, thrives on sunlight and heat, of which Florida has at worst a fair share. Why then are we debarred from raising this, the peer of all grapes? Traditionally the answer is contained in one word—humidity. Is it possible that with the wide distribution of this plant, that it has nowhere adapted itself to a climate similar to ours. Its wide distribution and its great antiquity must have evolved some few varieties that will grow in our climate and soils.

V. Vinifera thrives in New York State, and I personally can vouch for the extremes of that climate. Such humidity as we never have here, drought, deluge and all manner of the worst weather at the most unexpected times.

Viniferas thrive in France and Italy and God knows that there are thousands of American boys who can tell us of the meanness of the climate of those countries.

About the last thing that one encounters in going into the Big Deserts is a grape vine.

To be true most fungus diseases thrive in our climate as do countless biting, sucking and chewing bugs. Thanks to the Experiment Stations and Universities we have sufficient means for the control of all of these that attack the grape, and he who would be a viticulturalist had better start prepared or change his vocation forthwith.

Finally we find that one variety of this species has been grown here in Florida for some eight or nine years. Why just one variety out of thousands?

The answer to all of this must lay in just one direction—experimentation and study.

The foregoing facts, with some experience with V. Vinifera in other climates, is the real road by which I arrived at my Vinifera experiment here in Florida. Of the experimental work done by Baron von Luttichau for the department in Washington, I knew nothing till my work had been underway for nearly a year. I doubt that his work would have in any way affected my determination had I known of it at an earlier date. His work was fine and complete and the results most gratifying, but his line of investigation was so radically different from my own that his results would not disprove my theories. Meaning specificially that his procedure seemed to me to indicate that he took every possible precaution to ward off disease and produce fine vines and fruit. My procedure is to find out how much "grief" the vines will stand and still produce good commercial fruit, at the same time seeing how good fruit I can produce with the greatest care, and where the point of "vanishing returns was likely to occur, in spraying, fertilizing and training." Baron von Luttichau has demonstrated one very valuable fact to the people of Florida, that so far, very few have taken advantage of, i. e. that all of you may have the finest of all grapes if not the finest of all fruit in your gardens. The work that you would expend on them would be repaid to you a hundred fold. Much would be learned that would be of the greatest value to the State at large and most every one would be the gainer. The baron has given you a direct challenge that you have not taken up. Spend fifteen minutes in my experimental planting and you will receive another.

I have in my experimental planting at Grand Island, over a hundred varieties of Vinifera grapes growing side by side with nearly an equal number of hybrids. The entire planting contains about 8,500 plants and nursery rows contain in addition some 20,000. To attempt to give you any idea of the identification of these would result only in an impression of a jumble of foreign names, but to those who are interested I will be glad to give all the specific information I have.

Let us sum up the facts which we have to determine the answer to question I.

1. We have four indigenous species, growing in profusion and bearing quantities of fruit, withstanding the ravages of insects and diseases and with all offering wonderful characteristics for hybridization with finer sorts.

2. Evidence of great possibilities in the importation of hybrids already developed, as shown by the elementary results already obtained.

3. The possibilities offered in the importation of varieties of V. Vinifera. This possibility for clearer understanding may well be divided into four subdivisions.

(a) V. Vinifera on its own roots. The least likely of all to succeed. Although even if the plants prove to be short lived and frequent renewals are required, considering the returns possible from lim-

ited planting of the fancy varieties, this might prove very profitable.

(b) Viniferas grafted on root stock, already known and proven, and which will do well here.

(c) Viniferas planted on rootstock developed from our native vines.

(d) Vinifera hybridized with our native and other vines, with Vinifera in attenuation of 3-4 or more, and the use of many more varieties of Vinifera than have been used for parents in the hybrids already made. A careful study of this question of hydridization indicates that only a very few varieties of Vinifera have ever been used as parents.

Without considering the question of grape diseases and insects—which I will cover later. The facts in favor of establishing a stable grape industry in Florida seem to me conclusive. As a conclusive argument spend fifteen minutes in my experimental planting.

Question II. "What varieties are best."

I have a fair reputation for truthfulness, and I wish to keep it. The answer to this question is not yet, and I doubt if there will be one best variety. I do not even know yet approximately how many good varieties there are. There are certainly a dozen or two of the hydrids, to say nothing of the Viniferas, that time will show to be successful.

In tabulating the results of my experiments, that I might get some comparative measure of the merits of the various varieties, I have used an arbitrary scale of five (had I had the time to be more constantly in my vineyard and to make more painstaking observations, a scale of 100 would have been better). Five being the best or highest and 0 the lowest.

In order that you may interpret these results into a concrete mental picture, I am using three of the best known hybrid grapes grown here in Florida, as a basis for comparison. Considering growth unaffected by insects or disease, I give Carman a growth rating of 3, Armalaga a rating of 3, and Ellen Scott a rating of 2, an average for all hybrids of 3, and for Vinifera, 5.

Resistance to Nematodes—All hybrids 4½. Vinifera 3½.

Resistance to Anthracnose—Carmen 4, Armalaga 3. Ellen Scott 2. All Hybrids 4½. Vinifera 4½.

Resistance to Downey Mildew—Carman 3½, Armalaga 4, Ellen Scott ½, all hybrids 4.

Resistance to Flea Beetle—Carman 5, Armalaga 3, Ellen Scott 2, all Hybrids 4, Vinifera 3.

Resistance to Leaf-Folder—Carman 5, Armalaga 4, Ellen Scott 5, all Hybrids 3, Vinifera 5.

Resistance to Phylloxera—None found as yet.

Resistance to Grape Leaf Hopper—Only a slight isolated attack.

Resistance to the Various Rots—Almost none present as yet.

Statistics are tiresome to any one who is not a student of the subject covered, so I have confined myself to the most common and serious diseases and insects.

To generalize, which is more interesting, though much less accurate, I have many varieties of Vinifera which will outgrow, and out fruit Carman (the most common grape in Florida), three to one,

having the relative resistance shown above. All Viniferas have shown a much higher resistance to Anthracnose than either Armalaga or Ellen Scott. All Vinifera varieties can be made more resistant as far as root system goes, than most all of the hybrids and as good as the best. Many varieties of the Vinifera are as resistant to Downey Mildew, as most of the hybrids. Most all of the Viniferas are entirely resistant to folder and blue beetle, while many of the hybrids suffer severely and require an extra spraying for one or both of these pests.

In no case has the behavior of the Viniferas been such, as to warrant their elimination for any reason whatever.

In the case of the hybrids (with the exception of a few plants for nursery purposes) I have eliminated a number for lack of resistance, poor growth, lack of resistance, lack of quality of fruit, etc., among which are Salem, Gold Coin, Catawba, Carman, Marcus, etc. I do not wish to brand these as poor grapes. They simply do not measure up to the standard by which I will eliminate.

So far, the Vinifera has the best of the chances to be the basis of a stable and paying industry. Unfortunately we have only gone a short way. On the Pacific Coast, the establishment of a full-bearing vineyard of Viniferas takes from 6 to 9 years. Here we may hope to shorten this time. Patient, careful experimental work alone will answer the question. Experimenting with 27 varieties will not tell the truth, nor should it be necessary to use 2,700. One good variety will not establish a grape industry. Lack of standardization will be almost as bad.

A collection of the facts bearing on the selection of the best varieties at this stage is not very imposing. However, in no grape region that I know of, is the industry founded on one variety. No one man or group of men, will ever know all about the industry or the varieties to use. California, with its mammoth industry, high degree of standardization and long experience, still supports some 14 experiment stations, and is constantly bringing forward new and valuable varieties. As a matter of fact, we, in the East, really do not know what good grapes are, for many of the best varieties will not bear shipping from the West Coast.

I can only say in closing this question: Do not adopt for planting one variety of grape only. Do not adopt any variety that gives all the profit to the nursery man. Above all remember that it costs more to raise a sorry grape than a good one.

Question III. "What is the quality of the fruit?"

Here indeed, is smooth sailing. There is very little comparison in quality between the Hybrid "Slip-Skin" and the meaty, highly and delicately flavored Vinifera. In the parlance of the prize ring. "This is the Viniferas round all the way through." Moreover the quality of the Hybrid goes up or down, almost in direct proportion to the amount of Vinifera blood that it contains. The superiority of the Vinifera over other grapes is not even open to argument, for, if we use as a final standard of measure of quality, the yard stick of dollars profit, the honors still go to the Vinifera by a large majority. The grape consumption of the country, exclud-

ing raisins, is composed of Viniferas and others about in the proportion of 30 to 1. Or you may use about this figure as the absorbing power of the market, or conversely, the selling effort required to dispose of your crop.

Practically all the wines are made from Viniferas; Alicante Bouchet, and Carignane selling on the N. Y. market for double the price of the table grapes, with which we are familiar, such as Thompsons, Tokays, and Emperors, etc. These in turn selling for double the price of the Hybrid "Slip Skins."

Taken by and large, everything is in the favor of the Vinifera when it comes to quality. Specific climates and root stocks, however, have the power to all but ruin the quality of a grape. This is, however, about the only dark cloud on this horizon.

I have already mentioned that I have had success with some of the known and tried root-stocks. Their behavior should satisfy us on that point and should lead us away from the growing practice here in Florida of using complex fruiting sorts as root stocks. The development of a root-stock is a long and expensive matter, and following such roads as are being used here, all too often becomes a squirrel path and goes up a tree.

All of the fruit that I have produced, left nothing to be desired in the way of flavor, sugar and acid content and general quality. Any danger from this source, with the use of proper root stocks, may I believe, be forgotten. This year I will fruit some fifty additional varieties and can then furnish additional verification of this fact if it be needed.

I do not mean by what I have said to discourage any one from raising the Hybrids. The ultimate answer may be in this direction though I do not think so. Possibly through some American Vinifera Hybrid, containing a large percentage of Vinifera blood. We certainly can grow hybrids of this character here, hybrids of much better quality than those we are now working with.

No plant in the whole universe can surpass the grape in the reward it offers, for good grooming and sufficient food. Remember, "It costs more to raise a sorry grape than a good one."

Question IV. "When do they ripen?"

As the result of pure error or propaganda, there seems to be a somewhat general belief that the California grape crop is on the market earlier than it really is, which would make it appear that we would meet serious competition from California.

Our midseason and late varieties will ripen with the early varieties from the Imperial Valley, and will have to be marketed in competition with them, but if our entire crop ripened at the same time as the Imperial Valley crop, we need have little worry, as the total crop from there is but a "drop in the bucket" of the total grape market of the country.

The main crop from California which comes from the great Central Valley, is in reality late; a fall crop. Late August, September and October, brings the bulk of it, with a continuation of shipping up to February.

To be exact and to eliminate question, let me give you facts from three authoritative sources:

From the California Grape Grower of March 1, 1925, the total unloads for the season by months in N. Y. City up to December 1, 1924, was as follows:

	Cal.	Others
June	1	1
July	143	2
August	857	7
September	4157	56
October	6111	590
November	2095	305
Total	13,364	961

These figures show that up to September 1st, about one-fifteenth of the crop is shipped, and during September and October, about 12-15ths are shipped.

From "California Fruits," Edward J. Wickson, Professor Emeritus, University of California. "By choice of early and late varieties, the grape season extends over half a year in California." "Where the fall rains are not very protracted, the late varieties sometimes remain in good condition on the vines until the winter pruning. "Good grapes have been picked from the vines as late as the middle of January. In the Lodi district of the San Joaquin Valley (one of the great centers of the shipping industry) overland shipping begins about August 10th, and Black Prince, Tokays from light soil soon follow; then from heavy soil, and in about two weeks everything is going full blast, keeping up strongly for nearly two months."

It will be seen from the foregoing that heavy shipping does not commence for at least three weeks after August 10th, or approximately September 1st.

From U. S. Dept. of Agriculture Bulletin, by Geo. C. Hussman, I am giving the dates of growth starting, compared with dates in my vineyard for half a dozen varieties, as well as an approximate average for all varieties which I am now growing, and which are listed in the bulletin:

Variety	Growth Starting	
	Cal.	Fla.
Bakator	March 23	Feb. 15
Carnignan	March 25	Feb. 21
Chasselas Rose	March 28	Feb. 21
Cornichon	March 28	Feb. 20
Gradiska	March 20	Feb. 12
Malvasia Rosario	March 12	Feb. 12

The average for all varieties in California is about March 25th, whereas most of the varieties in my vineyard had started growth well by February 15th, and some were well started by February 5th.

The average blooming date for all Viniferas in California in an early season is about May 25th. The average date in my vineyard was about April 4th.

All the figures given for California are for an early season, while those for my vinyard are this years, and growth was retarded as much as possible by the method of fertilization cultivation and pruning that I used. As to the earliness of the season here you are better judges than I.

I am not attempting to make a comparison of fruit ripening dates, as the results I obtained last year were so upset by a bad burning with Bordeaux, and the fact that most of the vines were newly set, as to make the results of little value in basing a conclusion.

What can be depended on as a true guide to the fruit ripening dates, is the seasonal sum of "heat," i. e. The sum

total of the average or mean daily temperatures. It has been demonstrated that when this total reaches 5400 degrees, sufficiently high daily temperatures have existed to have ripened the fruit. Florida, hereabouts, adds up this total of daily temperatures at a much earlier date than does the great valley of California.

June 10th to August 10th will cover the ripening date for most all of the Viniferas, as well as the hybrids. Pearl of Csaba, Black Malvoise and others, on proper root stock can be ripened considerably earlier.

These ripening dates show that we will ripen any crop of grapes from two to six weeks ahead of other localities in the U. S.

Question V. "What is the market for Florida Grown Grapes?"

As far as I know, no recent attempt to market Florida grown grapes, in sufficient quantity to be used as a guide for the future, has been made. The best guide then, is an analysis of the conditions under which they must be sold.

There are two distinct phases of the grape market, radically different in their ability to absorb volume of product, though the same variety of grape may enter, to a certain extent, into both.

First the Table or Desert Grapes, such as Tokays, Emperors, Malagas, etc. Then the wine grapes, Alicante Bouchet, Zinfandel and Carignane, which California now calls, "Juice Grapes." Personally I do not like the apocrypha of the term, nor do I care to defer even this much to the vicious minority, which through the weakness of our political procedure, is able to force its will on the majority of the people of the United States, debauch the youth of the country, and destroy the effectiveness of constitutional law.

The most outstanding fact about the two classes of grapes, is the difference in market value. Alicante Bouchet brought on the N. Y. market last year, an average of about $2.50 per lug, while the average for the Malagas, Tokays etc. was about $1.30, and this relative difference has existed in about the same proportion ever since the advent of prohibition.

The second most important fact is that the market will absorb what seems like an unlimited quantity of wine grapes and still hold the price fairly well, while the opposite and normal condition holds for table grapes. Most any kind of a juicy grape will find a ready market these days.

The third important fact is, that the wine varieties on the whole, give more promise of quantity of fruit than the table grapes and will be less affected in quality of product by the introduction of a small quantity of Native Grape blood, than will the table varieties.

The facts of the case would indicate that the wine grape industry would on the whole be more profitable and easier of accomplishment, than that of raising the table or desert varieties. I believe this to be a fact with the exception that the able varieties may prove as profitable or more so up to the point of market saturation for early varieties.

I have endeavored up to now, to give you some sort of a bird's eye view of the whole grape situation as I see it and it's bearing on the experimental work I am

carrying on. I would perhaps have been more in order, had I held more closely to field work. I will try to atone for this and give a general idea of just what I have done, the successes I have met with as well as the misfortunes: The selection of a vineyard site was a long task with me, I did not wish to prejudice my work by either too good or too bad a location. I insisted only on fair soil (as Florida high pine land goes), a free sweep for the wind, good air-drainage, good sub-soil drainage, water-table at least ten feet down, and clay not nearer the surface than this figure.

Much has been said that need not be repeated, of the necessity of good drainage for vineyards, yet I do not think that it is fully appreciated, that a great many varieties of grapes are really very deep rooted, ten to twelve feet average with as high as 25 feet. To be true, a grape will live where many plants will die, and bear fruit at that; but will not satisfy in the quality and quantity. Its response to good treatment is as wonderful as its determination to grow on and produce under the most adverse conditions.

Procuring various varieties of the Munson and other hybrids was, of course, quite easy when it came to the Viniferas, it was quite another story. I was obliged to canvass every possibility, picking up few varieties here and there, in many cases being able to get only cuttings and often being obliged to pay a ridiculous price; but inside of 12 months I had collected nearly a hundred promising varieties and have since increased this greatly.

After procuring as many varieties as seemed wise, I was faced with the problem of a good root stock. I had and have, very little faith in the Native wild vines or the complex Hybrids for this purpose. In neither case have we any real knowledge as to their behavior. I therefore turned to the most promising of the root stocks in use in California trying at the same time some of the fruiting hybrids, most of these being of simple parentage.

I have so far used some 23 stocks, grafting to each, only such varieties as were known, or were likely to bring satisfactory results. There is nothing to be gained from indiscriminate grafting without any knowledge of the effect of so doing on the quantity, quality and date of ripening of the fruit, as well as the affinity of stock and scion and the consequent probable longevity of the vine.

In addition to grafting these stocks, I carried them through on their own roots ungrafted that I might note the behavior of them all in our climate and soil. So far I have yet to find any better stock for our use than many of those already developed, though I am far from believing that a better stock for Florida cannot be evolved.

Of our Native vines, I find much has been said that is not true of them when in their proper environment, and some of these statements are by the most eminent authorities.

It is stated in most viticultural works, that they do not root readily from cuttings, yet I have this season taken cuttings from Cinera Hybrids from my callusing bed, that had callused and even formed roots very nearly as well as the

Vinifera cuttings that were treated in the same way. These cuttings are now growing nicely, in my nursery.

It is generally stated that our native vines do not bench graft readily, but a more or less half hearted attempt on vines that were structurally almost impossible to graft, netted me over a 50 per cent take.

Both these facts are in favor of using these varieties as root stocks, yet they all, (Simpsonii and Cinera) have very marked affinities and many varieties of Vinifera are refused by them. The tendency of these grafts when they do take, seems to be toward a lack of fruitfulness.

I have so far, found a little time for hybridization, and most of the work that I have done along this line, has been in the search for a better root stock for Florida, though no small amount has been done to produce new fruiting sorts. I procured last season several hundred seeds and hope to increase this by several thousand more this year.

In setting my vineyard, I believed it best, in spite of the lack of convenience, to split my Vinifera planting in two parts that I might be surer to get more diverse soil and drainage conditions. This was a wise precaution, as a very marked effect has been produced on growth by different soil conditions. Also by the proximity of woodland to one part of my Vinifera planting. The attacks by Leaf Hoppers, Blue (Flea,) Beetle, Folders etc., has been much heavier in that section than in the other. The same condition has existed in relation to the Fungus diseases. These conditions are as might be expected, but were worth verifying, and yet more worth remembering, in considering a vineyard site as well as in the study of the relative behavior of different varieties, or the same varieties in different localities.

So far in my work I have followed precedent and tradition, the two great millstones around the neck of agriculture. If I were to really try to raise Viniferas away from the arid and semi-arid states, then I must forswear all precedent and tradition. I was literally thumbing my nose at fate and undertaking an almost impossible task. No where except from Dr. Hedrick and his work, could I find any encouragement. Three other things contributed about equally to the formation of my belief that we were missing an opportunity to raise, at least some varieties of Viniferas.

That a comparison of the humidity tables, for certain of the grape regions of the Pacific slope, with those of Florida, for the ripening period of the crop in each state, showed much more comparative figures that one would imagine possible.

That the seasonal sum of heat required to ripen the crop here, came quickly, and at a much earlier date than in the west, with but a shade less daily average sunshine.

That I had no little desire to be an Iconoclast in this matter and thorough accord with Dr. Hedricks belief that no work is so thoroughly bound up in tradition as Agriculture.

Humidity! This word has acted as an impassable barrier against the attempt to raise Viniferas in the East. Because of it fungi and insects thrive, that can-

not do so in the arid climates. Yet it is a much abused term, or rather a much misunderstood and misused word.

It would seem that because the arbitrary measure of relative humidity has been designated as the figure 1, the point at which the amount of water in the air becomes so great that precipitation begins; that many of us believe that relative humidity is in exact proportion to the amount of rainfall. This relation does not exist, and it is not axiomatic that high rainfall always means the same and high relative humidity. Humidity of between 80 and 90 may exist for a month without a single bit of precipitation or rainfall. Conversely, there may be four or five inches of rainfall during any one month, with a mean relative humidity averaging as low as 40 to 60. Humidity is by no means constant over a given area. Low, heavily wooded, with poor soil drainage, with poor air drainage, or tracts entirely surrounded by heavy woods, will have a much higher relative humidity than, high, cleared tracts with good soil and air drainage and where sun and wind have full sway.

Our high pine lands, with good sand loam, not surrounded entirely by woods, will have a markedly lower humidity than most of our Hammock lands. Better yet to keep away from uncultivated wood land on all sides. Then you may have heavy rainfall and relatively low humidity. Good air drainage, bright sunshine and fair winds, will do what spraying cannot, and will reduce the spraying bill for the year by half.

There are, I believe such things as "Paper Facts," as well as paper profits, and they are alike in one respect, you have to "take" one and "demonstrate" the other before either is of any real good. There is one Paper Fact that has been in no wise demonstrated in my experiments, and that is the question of the longevity of any Vinifera planting. Baron von Luttichau has given us some very valuable information on this, and it would seem from his work that we may expect sufficient longevity from Vinifera plantings, to at least warrant making them. Much is yet to be learned on this subject.

My vineyard has suffered no end of abuse at my hands, some intentional, much otherwise. In the early history of it, it was badly burned with Bordeaux through the use of bad lime in the mix and lack of Potassium Ferro Cyanide for testing the mix after it was made. It has been burnt slightly twice since then. When ever worked pressed and something had to be neglected, it was always the vineyard in favor of the more intensive and valuable crops. Spraying, cultivating and fertilization have been put off or entirely omitted, to the danger point, yet all the varieties have done well, and some have surpassed any hope that I had felt, even had the very best care been given them. They are thriving, growing in luxury, and bearing as large a crop as is safe, of fine quality fruit.

Of the willful abuse of the vineyard I will mention only a few of the things that I have done. Severe root pruning, summer pruning; very early and very late top pruning of the most radical sorts; positively forcing shallow and deep rooting, I have as yet, not sprayed this year

to get a good check on resistance to Anthracnose.

All of this radical experimental work, has so far given me some valuable points on root-system development and has convinced me that I can propagate better vines with dry mulching than with irrigation. Dry mulching, is perhaps a bit more work and a bit more expensive but considering the drought insurance and the quality of the vines produced, "The Game is Worth the Candle."

Any one who, like myself, turns his avocation into his vocation, once being "wound up," never "runs down." I will therefore "put on the breaks" and directly will come to a full stop.

To those of you that believe the ultimate answer to the grape question in Florida has been found, I suggest again, that you take the time to look over my vineyard and nursery, bearing in mind what I have said to you, and the abuse that it has had.

To those of you who are purely upholders of tradition I have no apology to make.

To those of you who are learned and experienced in agriculture in general, and viticulture in particular, I wish to ask your indulgence, and to assure you that I have undertaken my experiment with an open mind, and with years of experience and study in scientific, though different, fields.

To the man, I do not remember who, or how large he was, that told me that some day I would come to raising one certain variety of grape only, I wish to relate a little anecdote:

I once asked a Scotch neighbor of mine, if he was going to do the almost too generous thing and allow another neighbor to get the better of him in a trade, and Scotti replied:

"A pig mout wistle but he ha a werra unlikely muth."

A System of State Parks

Miss Elizabeth Skinner, Dunedin

Mr. President and Members of the Horticultural Society:

Before speaking of the parks, I just want to refer to the talk I gave last night on the Recommendations of the Children's Code Commission, and call your attention to the fact that copies of that report to the Governor and the Legislature can be had in the lobby of the church, and I hope each one will take one, and if you feel in sympathy with these recommendations that you will write to the Governor and to the members of the Legislature and express your opinion.

It's always a great pleasure to speak on the Royal Palm State Park. I have had the pleasure of being present at the Federation of Woman's Club, and therefore am quite closely connected with it. The first experience I ever had was at the dedication of that park in 1916. Then there were no good roads to speak of, and the road leading to the park was an eye-opener to what we could have, if we went after it, and the women and the men of that part of the country that laid that road, that made it possible for us to dedicate the park, deserved all the credit we could give them at that time. They labored hard to make the park a possibility, reaching over the Everglades that were covered with water, and over the corduroy roads that they had laid.

I am going to take you 48 miles south of Miami. The park consists of 4,000 acres; 300 acres of the 4,000 are called Paradise Key. That is the heart of the park. It is the part that is reserved for science, and people of the State, because of its tropical nature. There are only one or two other places, and one of those has been sub-divided.

The nature of the park, lying right in the Everglades that have been covered with water until recent days, is full of Royal Palms, looming up above the lower growth, of all kinds of tropical trees. I hesitate to speak of this before scientists, because I don't know the scientific names, but to any scientist going down there, there is a world of interest and information. I have met in my various visits to the park, scientists from different universities and from different research stations, studying myriads of insects, and they apparently find treasures. Everything in the way of any insects, butterflies, bird, tree or plant, or anything else, is preserved there for those who are interested.

The Royal Palms loom up above the rest of the tropical growth and the magnificent appearance of those palms make you feel that the park is well named. We say it with a great deal of reverence.

Mr. Blacksley, the well-known naturalist, (and Dr. Simpson tells me he is one of the most renowned naturalists) is making a research of all the life of the

park, of everything that he can find there. With the help of other scientists he is going to give us information on each one of these phases of life in the park. This we feel will be very valuable for the people of Florida. He says his study will cover a period of at least seven years. This is his second year, and he is visiting the park and making records of all he sees and can find out about the park.

The park is ever in danger of fire. In the early days the Everglades were covered with plenty of water, which surrounded this key, and protected it. Once burned over the plant life you find on any key, is never the same, so it is up to the people of Florida to protect the park from fire.

We have started a fund of $25,000 to construct a mote around the 300 acres that we consider the heart of the park, Paradise Key. There is a protection from the lily-pad slough, that is very beautiful, and this can be continued around the park, with a driveway making it wide enough so it will protect the park from fire. We feel that this, too, will protect it from maurauders, insects, and different kinds of enemies of plant life, that are being brought into the park continually, because it is the main highway to Cape Sable, and they seem to think there are no speed limits that far from Miami.

Mr. David Fairchild has been very much interested in the protection of the park, and he asked an artist friend to design a medal. He proposed that we offer this medal to anyone that contributed to the park, to protect it from fire. The medal is very decorative, and is a token that our friends of the park have contributed. If anyone of you wish to contribute, the medal is yours, and if you secure a large donation, you can have a hundred of them, but that has to be a real donation.

We have had 800 visitors to the park in one day. One month last year we had over 10,000 registered. That's not counting all the visitors that see the park and do not register, but it shows the popularity of a place like that. There is a delight here that you don't find anywhere else in the United States. It's just as the park naturally is. We are very grateful to the Legislature who have given us $2,500 each year, and by growing palms from seed, by serving lunch, by renting our rooms and some of our land, we have managed to raise enough money to carry on and make a few improvements each year. We had hoped this year that the federation would ask for a larger appropriation, but they are afraid they might loose what they have given, so we are keeping still, but we need a larger appropriation.

Any plantings we make about the park have to be protected. Because we have been so glad to have people come to Florida, they seem to think everything is theirs, and we cannot grow orchids and palms fast enough, so we have got to put the lid on and ask them to buy from the park instead of to help themselves.

We women who have grouped ourselves together desire very much to have a park on the Suwanee River, on some historic site. I think there are possibilities out by Chattahoochee, but that's when we cease to have any need for a hospital for the insane. Perhaps some day we can

take over Chattahoochee; the St. Johns River and our lake regions and many other sections offer opportunties. Many of our counties have beautiful spots and natural places of interest, which because of their unusual beauty should be preserved now and dedicated to park purposes, so we can enjoy the beauties of nature that have been given the State of Florida. Glacier Park has nothing on Florida. There are beauties of a different kind in our State.

Blackberries in Florida

H. G. Gardner, Bartow

In the past few years small fruits have made very rapid progress in Florida, they have been greatly neglected in the past, very few berries being grown except strawberries and what wild blackberries that were growing along old fence rows and long the small streams. Not until the last five years have many of the blackberries been grown, either for home use or market.

The Florida marvel (Rubus Velox Bailey) which was introduced at Daytona has made a most wonderful record, this berry is a hybrid between blackberry with dewberry, some of the characteristics of both. It is very prolific, large, round in shape, large druplets; the berry being some times over an inch in diameter. It is very early but acid in flavor until ripe, berry has very few seeds which are large and soft. This promises to be one of the leading commercial berries for a while at least.

The next most important berry at the present, is the topsy or tree blackberry (Rubus Probabublus Bailey), this is an upright growing plant not requiring any stakes, this is a tree blackberry, medium size, later than marvel, carrying much less acid, the druplets are small, each have a small seed which is almost unnoticeable. This berry is also making rapid headway filling a needed place either for home garden or markets continuing the ripening reason until well up in June.

Among the various berries that I have tried are the Himalaya, Loganberry, Coy thornless, those three have been found entirely worthless with me, but would like to hear from someone else in regard to same. The Himalaya did not bloom at all, the Loganberry was weak in constitution and died out in hot weather. The Coy thornless is the most interesting one, I have played with for the reason of its variabilities, I set out twenty-five plants of which but eight lived, they made a very rapid growth the first year, the foliage looking similar to an apple tree, very luxuriant, being dense and thick, entirely free from thorns. The following year this plant bloomed flowers, being almost shy of petals which were very small, very few fruit set, the fruit that ripened was insipid in taste, large, hard seed and large, tough core. The new canes that sprang up from base of plants showed wide variations. Some were the same as the year before, thornless, while a great many from the same plant would look as though they were brambles carrying so many thorns. The end of vines have tendency to blight late in season.

The Nessberry which has been lately introduced into this state from Texas, looks very promising, being a very hardy grower wherever it has been planted in the state. This is a dewberry, raspberry hybrid of excellent flavor, resembling the Loganberry, medium to large size berries,

druplets large and loosely set, some times shelling when picked, this promises to take the place of the Loganberry in Florida at the present time, being much hardier than the former. The Vanfleet raspberry is the first good berry to succeed in Florida, this particular one seem to be peculiarly adapted to our humid warm climate and long-growing season, where others will die down with the heat of summer, the Vanfleet grows more vigorous than ever, this berry is a hybrid between the old Cuthbert of the North which is so familiarly known and a Chinese introduction, it carries all of the good qualities of the Vanfleet and the hardiness of its foreign parent.

(Rubus Elipticus) advertised here in Florida as the yellow jacket; this berry was introduced some years back from the Himalayas, it was grown in Southern California and recommended for the covering of Pergolas and sheds sold in that state under the name of golden evergreen. It was introduced into Florida some years back and practically discarded up until very recently, now it is being advertised very highly, it is very susceptable to frost and will never prove of commercial value north of middle Florida. The berry is yellow in color, fair in quality, and almost inclosed in shuck.

Grape Problems of Florida

E. E. Truskett, Mount Dora, Fla.

It is not the object of this paper to give a scientific discussion of grape growing. Such a discussion would no doubt be of interest to many of you, but I suspect to the great majority here who are interested in grape growing for Florida, the thing that will be of most interest is the practical problems the industry has to face, and the particular problems we have faced and have found solutions for, and thus helped to place the grape industry on a good foundation for our state.

To any of you who may be in the grape-growing business, or who are contemplating entering that field, the main questions that will present themselves to you are about as follows. Can grapes be grown in Florida? On what types of land can they be grown? Can they be kept reasonably free from diseases and pests? Can they be marketed? What is the cost of production, and what the probable return?

We have been producing grapes in this state long enough to think we know the answers to most of these questions, to our own satisfaction at least, and to know that we have definite information on some of the questions. This information we are willing to pass on to prospective growers or to any who may now be in the business. Giving it free of charge, and any can accept it who wish, or any may turn it down, who do not like it. We have no land for sale, no nursery stock for sale, no vineyards for sale, so the information ought to be unbiased at least.

The question as to whether bunch grapes can be produced or not is easily answered. They can for we have and are producing and shipping them, in a commercial way big enough to convince the most skeptical. Black, purple, red, white, table and wine grapes can be grown successfully in Florida. Some of these do much better than others. Some require much less care than others. But all can be grown, and profitably so. We have in our vineyards two-year old vines with over 100 bunches to the vine on them, set now and doing nicely. These bunches will average about ½ pound per bunch or 50 lbs. per vine. With 425 vines to the acre this means a crop of 10 tons per acre. The vineyard will not average this of course, but in this particular block of two acres, that has this best variety on it, the whole block will make well over four tons to the acre, probably five tons or better. This block had two tons to the acre on it last year when the vines were only 16 months old.

That proves to our mind that large quantities of grapes can be grown per acre in Florida. This particular grape is just about like the Concord. In no way inferior to it, and in some respects it's superior.

Now if a white grape is wanted, because it may appeal to the table trade more than the black one, the Waupanuka which can be grown very successfully here is a better grape than the Niagara. It tastes better, will carry better, and makes a better appearance on the table.

If a reddish purple grape is wanted the Ellen Scott is as fine a flavored grape as grows in America. It is very delicate skinned and for this reason has to be handled carefully, but it makes fine large bunches (weighing as high as 2½ lbs. per bunch), and makes a beautiful appearance on the table.

If a very sweet grape is wanted, and we find some markets partial to this kind, then the Carman when properly grown is a very good variety. They are no sweeter than the Ellen Scott, but are a much better shipper and for this reason probably a better market grape. They are also more disease resistant, so will do better under ordinary care, and general vineyard conditions.

The type of land question is a little more difficult to be definite about. Some things are proven facts; i. e. Good drainage, both air and water, plenty of humus either naturally or applied in some form after the land has been prepared for setting, or after the grapes are growing. Other things are really only conjecture and some even have been proven untrue; such as clay subsoil, close to the surface. We have grapes on soil that has no clay under it at all, our best ones; then again we have good grapes where the clay is only two feet below the surface. In neither case can we attribute the success or failure of the grapes to the presence or absence of clay. The slope of the land has little to do with the location. East slopes put out a little earlier, but the time of ripening is very slightly different. We have good grapes on nearly flat land (but well drained) and we have good ones on a slope too steep to work mules up the hill.

In general it would be safe to say that any good citrus land will raise grapes. The better the land the more grapes will be produced per acre. The one absolute essential being good drainage. More grape failures in Florida are chargeable to poor drainage than to any other cause.

The subject of diseases and pests is well treated in the Bulletin put out by the Experiment Station, also in the booklet by Colonel Fisher, also the Department of Agricultural publications.

In this discussion we will look only at the practical side of the question. The phyloxera question can be handled by using the native roots and grafting on them, or better yet by using the hybrid grapes that are resistant to this pest almost to the point of immunity. At least to the point where it will give no real trouble. The same thing is true as to downy mildew. Those folks who will insist on trying to grow the Northern and European varieties, especially on their own roots, are going to have sad experiences, unless they are smarter than hundreds of other growers who have tried these to their sorrow, some of them in acreages running into the hundred. There are hybrid varieties, just as good as those Northern grapes at least, that will not be troubled by phyloxera or downy mildew, so we are growing these varieites.

We have some trouble with grape aphis, easily controlled by dusting or spraying. Also some trouble with grape leaf hopper, a little more difficult to control but easily possible. It comes too late to do very much damage even if no control measures are taken.

The biggest problem we have in the disease line is anthracnose, and the related grape rots. These need not be a draw back to grape growing if proper spraying is done, and it does not take so much spraying if the proper varieties are grown. Some of the Florida varieties are very resistant to these troubles and need very little spraying. Others need considerable spraying, but this is not so costly as to be prohibitive, and it takes no more spraying under Florida conditions that it does in the North or in California. So no one need fear failure in grape growing on account of diseases or pests, if the proper varieties are planted on the right kind of land and reasonable care be given the vineyard. One of the things we were warned against was the ripening of our crop in the rainy season and the fear of mildew, black rot and grape rots due to the moisture. We have had absolutely no trouble from these sources, nor will any one have trouble if reasonable judgment is used in varieties and spraying.

The cost of production per acre varies according to the kind of care given the vineyard, and the amount of fertilizer used. We spend about $150 per acre per year on our vineyards. We use lots of high grade fertilizers and give the vines the best of care we know how. Grapes can be produced at much less per acre, but probably only at a sacrifice in quantity and quality.

As to the question of marketing and the profits in the business, there is really too little data available to make definite statements.

We sold grapes as high as $400 a ton last year, and none that arrived in the market in good condition and were handled by honest dealers, brought less than $150 per ton return to us. In our small shipments by express we lost some grapes due to rough handling by the messengers, and due to our shipping a couple of shipments to dishonest commission merchants, a few of which still exist, we lost them completely. But disregarding these minor experiences we averaged about $200 a ton for our crop last season. From now on shipping in car lots under ice, we will loose no grapes in transit, and we hope to be able to eliminate the dishonesty in marketing them, so we confidently expect to get even more for the future crops.

As stated before we can produce over 4 tons to the acre on our best variety, which leaves a very nice profit in the business.

Summing up our experience (which extend over 10 years of Florida experiences), success in grape growing depends on the land chosen being suitable for grapes; on the location being near enough to other growers to be able to load into solid car lots; on the variety you try to grow, and on the care given the vineyards.

The land question is easily settled, as there are thousands of acres of good grape land in Florida.

The location relative to shipping with other growers can be worked out by each

individual. Don't neglect this point in choosing a location, for we firmly believe a commercial grape-growing proposition is doomed to failure, if it is of any size, unless you are located where you can load into iced cars. This means solid car lots of grapes.

The matter of care of the vineyard is an easy problem, for it simply means finding out from some reliable source, how to put out the vineyard. How to fertilize, spray and prune it. Then use ordinary common sense. Packing the grapes for market will come under this head, and should be given the consideration due anything that is going into a competitive market.

The last problem is the one of variety, and here we come to the cause of the failure of nearly all the vineyards that have been abandoned in Florida for the last 50 years. And there has been a large acreage abandoned, and herein lies the reason for the doubt in many folks mind as to the practicability of trying to grow grapes in Florida, one of the best natural grape countries in the world.

The majority of these failures were due to trying to use the Northern and European varieties on their own roots. This was the case with the large acreage that failed near Orlando a good many years ago. They tried to grow Niagara grapes on their own roots, and of course these vines never did well due to the ravages of the phyloxera. Concords have failed for the same reason, though there are some good concord vines in the state. There are many good vines of both these varieties, as well as other European varieties, grafted on the native roots growing in the state at this time. Grafting may be a desirable way to grow grapes, and we are carrying on extensive experiments in this line, having grafted 15,000 vines this year on a dozen different root stocks, but we cannot recommend this practice to the new grower yet.

Besides it is not necessary to grow grafted grapes, for we have good varieties that do not need grafting, but that can be grown from cuttings. Some of these varieties are the Carman, R. W. and Fern Munson, Bride, Extra, Ellen Scott, Waupanuka, Armalga and a good many others including a new variety (thought by some to be Beacon, but that we are quite confident is not Beacon).

We can only give our own experience with these different varieties and the observations we have made in other vineyards than our own. Any one disagreeing with these findings are at liberty to follow their own experiences in grape growing, but after growing all the varieties, on their own roots and also grafting on all the best known root stocks, we have finally specialized for the present on two varieties for market. We are growing several others experimentally and two of them show great promise, but we could not recommend at this time the planting of any but Carman grapes, or the new variety mentioned above, which we hope the Department of Agriculture will identify this season and publish the information for any who may be interested.

The Carman, when you get a good strain of Carman, feed it well, prune it properly and give it a chance, makes a good crop of nice grapes that market well.

The new variety when given the same

care will produce at least twice as many grapes at the same age, and for some tastes will be a better grape. In some markets one sells better; in other markets the other will sell best. The new grape is also the strongest growing variety we have found, the healthiest grape in our planting, the earliest maturing variety we have that can be called successful to date and the easiest rooted from cuttings.

One word of warning we would leave with any one who contemplates planting grapes, whether new in the business or those who have had experience, some of it bad. It is just as important to pick good strains of a variety of grapes as it is good strains of a breed of cattle, apples, corn, citrus fruits or any other thing that grows. Selection of the best individuals of a type, carried out for several years, will produce a strain that is in many ways superior to the general run of that type or variety. This is an old horticultural maxim that we all ought to know, but that we frequently forget, especially in a new industry like this grape growing is in Florida.

We have proved this selection pays, to our own satisfaction, by having tried it for ten years on certain varieties. In that time we have found one vine of one variety to stand out far in advance of all other vines of the same variety, supposedly coming from the same source and all having the same care. In this variety we only propagate from this one vine. In another ten years we have no doubt we will have developed a strain from this selection that is far ahead of our present standard. Let us all keep up this selection business and after while Florida will have a great industry to be proud of.

We should demand of our nurserymen, who expect to sell us grape vines, that they keep records of the vines from which the cuttings are taken, and that they will guarantee to us that the vines we buy are grown from these record-vine cuttings, and that they will show us the vines and the records. Only in this way can we get grape vines to plant that we can be assured will produce big crops of good grapes after we have gone to the big expense of bringing them up to bearing age. A little more expense for this kind of a vine to plant out will be a good investment when the vines begin to bear the much larger crops of much better quality grapes, that such vines will produce.

We can force the nurseries to give us this kind of service by patronizing the ones that first establish the practice and keep it up. Don't buy any large quantity of grape vines without seeing the vineyard from which the cuttings were taken, and knowing the record of production of these vines.

Florida Making a Good Beginning with Blueberries

H. G. Clayton, Gainesville

The blueberry offers an opportunity for the small farmer to produce this type of fruit satisfactorily and with a good profit for his labor. It requires no special training or experience with the culture of fruit to be able to succeed with the growing of these berries. The type grown in Florida (vaccinium) is native to this territory and so is already adapted to our climate and soil. Being a native, it has, up to the present time, been productive without the use of sprays for insects and diseases. The bushes begin to bear fruit the second year and production increases as they get larger with increased age. The oldest planting which I am familiar is about thirty years old, it has never yet failed to produce a crop each year and looks like it will continue to be productive for another 30 years. This berry is particularly adapted to the western part of our state.

There is today a considerable acreage planted to these berries in western Florida. The exact acreage is hard to determine because farmers have gone into the woods and taken up the wild plants which they have set out on their farms and collectors have gathered plants for shipping to purchasers over the state. Wild native-grown plants are not subject to nursery inspection regulations so no record can be gotten as to the number of plants which have been set. A good indication is to be had from a visit to the places in the woods which have been full of these plants for years, as now we find the bushes have pretty nearly disappeared. As a conservative estimate, it seems safe to say there are around 2,000 acres planted in this fruit.

Last year at the meeting of this Society, Mr. Carl B. James gave an interesting paper on blueberries and this paper appears in the last proceedings, so here I will try to touch the subject from a different angle.

TREES GROW SLOWLY THE FIRST YEAR

Most of the people in the middle and southern part of the state who have bought blueberry plants have been discouraged from the start. The plants are from the woods and so do not look like nursery stock to which they are accustomed. These plants when set out grow very slowly the first year, in fact about all they will do is to get well established, start a root system and put out a small top, all of which puts them in condition to make considerable growth the following year. Then there have been plants sold for blueberries which were not blueberries at all. Human nature is the same

BLUEBERRY PLANTS TAKEN FROM THE WOODS AND SET IN NURSERY JANUARY 18, 1924.

SAME PLANTING JULY 11, 1924, SHOWING GROWTH MADE.

BLUEBERRY PLANT 15 MONTHS FROM SETTING SHOWING EARLY FRUITING.

TEN YEAR OLD BLUEBERRIES.

everywhere and some people, either through ignorance or from gainful desire, have sold plants for June blueberries which were not blueberries at all.

BLUEBERRIES REQUIRE ACID SOILS

Most of our Florida soils are slightly acid, unless they have been treated with lime or other sweetening agents. Blueberries will not thrive on a soil that is not acid. This does not mean that they should be planted on low, poorly-drained land. They do best on medium-high land that is rolling and well-drained. Land that produces good yields of ordinary crops is usually well suited to blueberries.

PLANTING AND CULTIVATION

Plants should be set from 12 to 15 feet apart. These grow to a size of 12 to 15 feet high with considerable spread so it is not well to crowd them. They should be set to a depth of 6 to 8 inches. Frequent shallow cultivation similar to what is given young citrus trees is best for blueberries. Cover crops grown in the middles and turned under help to keep up the soil fertility and its humus content. In fertilizing we find organic sources of nitrogen best suited for this fruit. We want to keep the soil acid. A fertilizer which contains about 4% ammonia, 8% phosphoric acid and 4% potash gives good results.

PICKING AND SELLING

The bushes begin to bear a little the second year. The third year they should yield about two or three quarts to the plant, and when ten years old about 20 to 25 quarts to the plant. The picking season lasts from late May or early June till late August. The cost of picking is around 5 cents per quart and a good picker will pick around 60 quarts a day. The work is usually done by women and children and is nice work as there are no thorns and little stooping. The berries carry well and have so far found a ready market. The market far exceeds the supply at present. They are shipped in crates like strawberries. A considerable amount was shipped out of West Florida by express last year; this will increase this year and by 1926 it seems likely that carlot shipments will go out. The average price f. o. b. shipping point has, for the past two years, been around 25 cents a quart.

FRUIT THE SMALL FARMER CAN GROW

This fruit is so well adapted to the requirements of the small farmer that one does not wonder at them rapidly taking it up. They do not need expensive equipment and they fit in nicely with the ordinary cropping systems. On large acreages the labor requirements at picking time will be a handicap. Mr. W. A. Sapp, of Crestview, the man who started the blueberry to growing under cultivation in West Florida is a small farmer, he was very fond of blueberry pie but found it inconvenient to go to the woods and pick them very often, so one day he brought a few plants to the house and planted them near the house, probably thinking that, if they would grow, this would be the end of his trouble as the wife could then pick them and he could have pie often. These bushes did well and his planting was increased and it is from the results he secured that others became interested, and to this beginning our young blueberry industry owes its start.

Annual Reports

REPORT OF TREASURER

Receipts

1924		
Apr. 22, Balance in bank		$1376.47
1925		
Feb. Patron Memb. Penn. Chem. Co.	100.00	
Apr. 6, Total interest	161.49	
Apr. 9, Cash from Secy. B. F. Floyd	812.91	
		$2450.87

Expenditures

1924			
Oct.	E. O. Painter Ptg. Co.	1173.66	
1925			
Mch.	Premium Treas. Bond	25.00	
	Liberty Bonds	254.00	
			1452.66

Resources

Resources	587.91		
Savings Account Snell Bank	81.42		
Perennial membership account	53.00		
Patron membership account	50.88		
" " "	225.00		
			998.21
Bonds—Patron membership L. Bonds, 2nd and 3rd issues as per bank receipt attached, dated April 6th, 1925	2850.00		
Stock—Stock of Fla. W. I. Corp.	500.00		3350.00

Twenty shares of preferred, par value $100.00 each,
Ten shares of common, par value $100.00 each,
No dividends received to date on this stock.

(Signed) L. D. NILES,
Treasurer.

REPORT OF SECERTARY

Receipts

From patron memberships	$200.00
From life memberships	75.00
From sales of reports	63.66
From interest on bank account	2.77
From 1924 memberships	534.00
From 1925 memberships	1040.00
Total	$1915.43

Expenditures

28 bills, totaling	$1102.52
2 checks to Treas. Niles	812.91
Total	$1915.43

REPORT OF AUDITING COMMITTEE

We, the undersigned, members of your auditing committee, beg to report that we have examined the books and vouchers of the Secretary and Treasurer, and find them to be correct as follows:

Secretary's Books

Total monies collected		$1915.43
Bills and expenses paid	$1102.52	
Remittances to Treasurer	812.91	1915.43
Receipts		
Balance on hand Apr. 22, 1924		$1376.47
Receipts		1074.40
Total		$2450.87
Disbursements		1452.66

Treasurer's Books

Balance on hand ---------- $ 998.21
Liberty bonds, as per bank receipt attached ---------- 3350.00

Stock of Fla. West India Corp., as per bank receipt attached---20 shares

(Signed) S. C. WARNER,
C. W. LYONS

SELECTION OF MEETING PLACE FOR 1926

Invitations were extended from Winter Haven and Cocoa. Cocoa was unanimously selected as the meeting place for the 1926 meeting.

Resolutions

Inasmuch, As the preservation of the natural resources and beauty spots of our State from ruthless waste and destruction is and always has been one of the chief aims of this Society, therefore,

Be It Resolved, That the Florida State Horticultural Society, now in its 38th annual session, does now urge that suitable legislation shall be enacted by the State Legislature now in session at Tallahassee, providing for the creation and maintenance of a State Forestry Commission; and further be it

Resolved, That said Forestry Commission shall have a department known as the State Park Board; and further be it

Resolved, That as no bill looking towards the establishment of this Commission has as yet assumed definite shape that this resolution be placed in the hands of the Legislative Committee of this Society with power to act.

Passed.

Since Mr. Barron Collier has offered to give to the United States Government a tract of 300 acres located in the Royal Palm Hammock, Collier County, this tract to be set aside as a National Park,

Be It Resolved, That this Society does now respectfully urge our representatives in Congress to take immediate steps looking towards the acceptance of this generous offer.

Passed.

Be It Resolved, By the Florida State Horticultural Society at its 38th Annual Meeting at Eustis, Florida, this 9th day of April, 1925, that Citrus Aphids presented a real menace to the citrus industry of Florida and there were not sufficient funds available to the Plant Board for providing extra men to study the situation and discover new and effective methods of control, and

Whereas, The Executive Committee of this Society met and through proper committee presented the matter to the new Governor of the State, the Honorable John W. Martin, and,

Whereas, The said Governor, the Honorable John W. Martin, took immediate steps in the matter, recognizing the im-

portance of the industry and the necessity for prompt action, and in co-operation with the State Plant Board and the State Board of Control, set aside from the Emergency Fund $10,000.00 for the purpose of discovering effective means of control. Therefore, be it

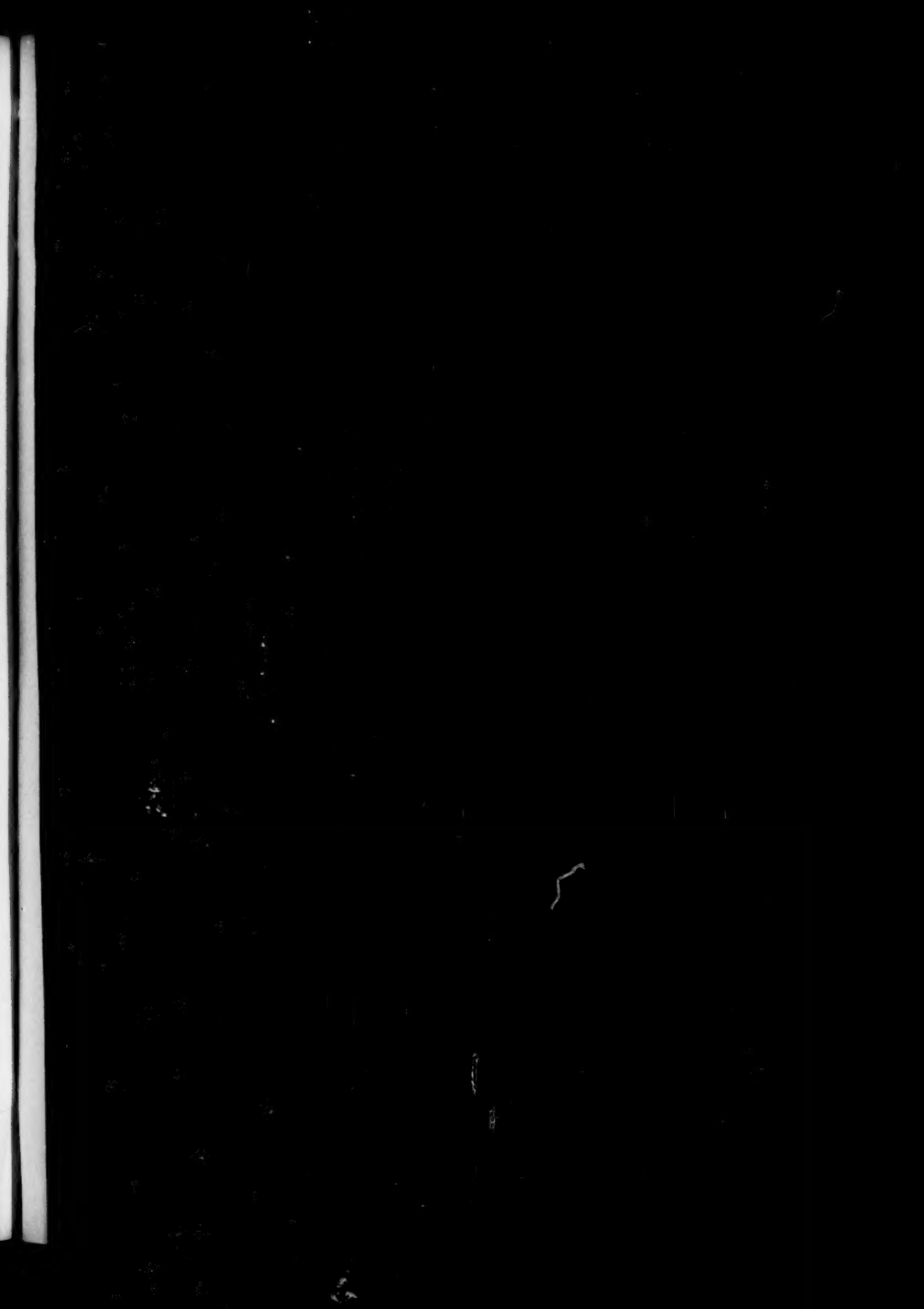
Resolved, That we, the State Horticultural Society extend to the Governor, the Honorable John W. Martin, this expression of appreciation for his broad vision, prompt action and efficiency in giving immediate relief, and that this resolution be spread on the minutes of the Society and a copy thereof furnished to the Governor, the Honorable John W. Martin.

Passed this 9th day of April, 1925.

BAYARD F. FLOYD,
Secretary.

Final Resolutions

On behalf of the Florida State Horticultural Society, cordial thanks are hereby extended to the various organizations, agencies and citizens of Eustis, who have contributed so delightfully to the success and pleasure of the 38th Annual Meeting of the Society.

We wish to extend thanks especially to the Chamber of Commerce for their efficient arrangements contributing to our entertainment, the boat ride and motorcade; to the Women's Club for providing floral decorations and holding the attractive flower show in connection with our sessions; to the pastor and officers of the First Presbyterian Church for the use of the church auditorium as a meeting place; to Professor Goethe, Superintendent of the Public School, for the use of projection lantern and daylight screen; to the citizens of Groveland and Howey for the entertainment and refreshments on the most interesting motorcade; to the Lake Region Country Club for extending the hospitality of the club and grounds to the members of the Society; to Mayor Bishop for his cordial welcome and the extension of police protection to guests' automobiles during the session; to the Daily Lake Region, its editor and associates for the complimentary papers and publicity furnished in regard to the meeting, also to the state press and magazine publishers for their co-operation in providing publicity and publication of reports; to the managers of the Eustis hotels for their courtesies and co-operation.

E. N. REASONER,
T. R. ROBINSON,
Committee on Final Resolutions.